JPL PUBLICATION 80-70

Stereosat: A Proposed Private Sector/Government Joint Venture in Remote Sensing From Space

Richard L. Anglin, Jr.

August 1, 1980

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL PUBLICATION 80-70

Stereosat: A Proposed Private Sector/Government Joint Venture in Remote Sensing From Space

Richard L. Anglin, Jr.

August 1, 1980

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

ABSTRACT

Stereosat, a free flying sun synchronous satellite whose purpose is to obtain worldwide cloud-free stereoscopic images of the Earth's land masses, had been proposed as a joint private sector/government venture. A number of potential organizational models were identified. The legal, economic, and institutional issues which could impact the continuum of potential joint private sector/government institutional structures were examined. The conclusion reached was that a number of organizational models could meet the sometimes conflicting policy objectives of the government and the private sector. While some legal, economic, and institutional issues impacted the choice of institutional structure, none barred any model.

ACKNOWLEDGEMENTS

The Stereosat Policy Study Task has been supported by a number of persons. The study was sponsored by the Non-Renewable Resources Program, Code ER, National Aeronautics and Space Administration (NASA), under the direction of Dr. James V. Taranik with the assistance of Mr. Bruton R. Schardt. Mr. Dan Schneiderman, Manager of the Earth Observation Program in the Office of Technology and Space Program Development at the Jet Propulsion Laboratory (JPL), provided the programmatic overview, and Mr. Allan G. Conrad, Manager of the Stereosat Development Flight Project, integrated all of the various mission studies, including this task. Dr. Roger D. Bourke, Manager, Systems Analysis Section, was the cognizant line manager.

Mr. Richard L. Anglin, Jr. managed the Stereosat Policy Study Task and was responsible for the legal and institutional analysis. Ms. Mildred Goldberger contributed to the analysis of existing institutional structures. Dr. Tom K. Lee examined some economic issues with the assistance of Mr. R. Mark Issac and Mr. Venkatraman Sadanand; Dr. Eugene H. Warren, Jr. surveyed socioeconomic issues. Insight into the market for stereo data was provided by Dr. Charles F. Hutchinson.

Three consultants undertook specialized analyses in support of the task. Dr. Louis L. Wilde, Associate Professor of Economics, California Institute of Technology, examined questions of project risk and project impact risk. Mr. William F. Baxter, Professor of Law, Stanford Law School, helped identify and assess the constraints upon potential joint private sector/government institutional structures. Gen. Martin Menter (USAF retired) analyzed the

international implications of the Stereosat mission in light of the Outer Space Treaty of 1967, to which the United States is a signatory.

A presentation of some of the findings of this study to the National Oceanic and Atmospheric Administration (NOAA) Satellite Task Force was supported at JPL by Dr. Amy L. Walton, Mr. Steven C. Jarmus, and Dr. James R. Huning.

During the course of the study numerous individuals and organizations, both in the private sector and government, were contacted and provided valuable insight and information. Without their generous support the task could not have been completed.

Special thanks go to Ms. Jeanne Wadsworth and Ms. Fern Buches for typing this document and shepherding it through to final publication.

TABLE OF CONTENTS

PAGE

List of Figures

PROLOGUE

The Stereosat Policy Study was undertaken over a period in which the confluence of a number of forces both within government and the private sector resulted in significant changes in the United States civilian land remote sensing program. The Stereosat Program can most easily be understood when viewed against the backdrop of this movement towards an integrated civilian land remote sensing system.

Civilian land remote sensing from space began with the launch of Landsat-1 on July 23, 1972, followed by a similar Landsat-2 on January 22, 1975. Landsat-1 and Landsat-2 detect solar radiation reflected from the Earth's surface in visible and near-visible wavelengths using a multispectral scanner (MSS). Landsat-3, launched March 5, 1978, detects emitted thermal radiation in addition to reflected radiation. All three Landsats were designed as research and development satellites and were not intended to provide continuous data. They were proof-of-concept research activities. Landsat-1 ceased operation on January 10, 1978, after almost five years of continuous operation. Landsat-2 ceased data collection in November 1979, but efforts are under way to correct the problems. Landsat-3 continues to collect data but has been experiencing problems with its tape recorders. All of these satellites have continued to operate well beyond their nominal lives.

It is this continued operation of Landsat-1, -2, and -3 beyond their nominal lives that is the genesis of some of the impetus towards an integrated operational remote sensing system. An integral part of the Landsat program has been funding of scientists to experiment with remote sensing data to develop new applications, and the creation of regional remote sensing training

and user assistance centers to transfer this technology to a wider spectrum of users. These efforts may be judged a success because a large user community has developed which relies on Landsat. Some users benefit from the high altitude synoptic perspective; others from seeing the same spot on the earth every eighteen days.

As the user community grew and the potential applications of Landsat data increased, both in the United States and in foreign countries, users became aware of the inherent limitations of the existing Landsat satellites. While some users had become dependent on a steady flow of data, the satellites grew older, each operating beyond its design life. The prospect of an interruptible flow of data led to expressions of concern to both the executive and legislative branches of government, each of which responded differently.

In 1977, in the Ninety-Fifth Congress, Senate Bill 657, the Earth Resources and Environment Information System Act, was introduced with the objective of establishing a remote sensing system. The executive branch opposed passage because they felt the legislation was premature. S.657 was not reported out of committee.

Two years later, in the Ninety-Sixth Congress, two bills were introduced to create an operational remote sensing system. Senate Bill 663, the Earth Data and Information Service Act of 1979, would create an agency within the National Aeronautics and Space Administration (NASA) to acquire, process and disseminate Earth resources data until an appropriate institutional mechanism is defined to transfer this activity to the private sector. Senate Bill 875, the Earth Resources Information Corporation Act of 1979, would establish a private corporation to operate a commercial Earth resources information service. Hearings have been held on the bills and both remain under consideration.

In June, 1978, the President issued Presidential Directive/NSC-37, entitled "National Space Policy", stating the principle that the United States would develop and operate active and passive remote sensing operations on a global basis. PD-37 also created a National Security Council (NSC) Policy Review Committee (PRC) to formulate a civil space policy to encompass the concepts of domestic commercial exploitation of space and the widest practical dissemination of data from civil space programs.

The studies undertaken by PRC (Space) led the President to announce a U.S. Civil Space Policy in October, 1978. The President committed the United States to "continuity of data" from the Landsat system, and directed NASA and the National Oceanic and Atmospheric Administration (NOAA) to prepare a plan "to encourage private investment and direct participation in civil remote sensing systems." The study which was to be the basis for the plan, "Private Sector Involvement in Civil Space Remote Sensing Systems" (PSIS), released June 15, 1979, concluded that it was premature to select specific institutional mechanisms for transferring Landsat to the private sector.

Continuing studies by PRC (Space) resulted in Presidential Directive/ NSC-54, entitled "Civil Operational Remote Sensing," assigning management responsibility for civil operational land remote sensing activities to NOAA. In assuming that responsibility, NOAA was to prepare a transition plan and seek further private sector involvement. NOAA released a document discussing issues and options for planning a civil operational land remote sensing satellite system on June 20, 1980.

The original idea for Stereosat as an independent mission complementing Landsat was presented to NASA in the middle of 1976. Preliminary studies demonstrated the scientific and technical viability of the mission. As the mission was configured, however, it went beyond traditional research and

development. At the same time, members of the potential Stereosat user community were saying that Stereosat might be a viable commercial activity. The result was that NASA, in its mission studies in Fiscal Year 1979 and continuing Fiscal Year 1980, began to investigate the potential of joint private sector/government implementation of Stereosat.

The Stereosat Policy Study Task commenced in April 1979. The Jet Propulsion Laboratory (JPL), in its role as the Stereosat Project Manager, was asked to investigate the potential for joint private sector/government involvement in Stereosat. It should be recalled that the Private Sector Involvement Study (PSIS) was released in June 1979, and PD-54 issued in November 1979. This study was being undertaken in a time of considerable uncertainty about the future of civil remote sensing. A commitment had been made to "continuity of data" and to increased private sector involvement, but the extent and form of these commitments were unknown. Thus, while some segments of the user community were advocating immediate implementation of Stereosat, others were adopting a "wait-and-see" attitude until more was known about the full scope of civil remote sensing systems.

A fundamental issue which became evident in this study was the perception of the commercial viability of Stereosat as a necessary precondition to private sector involvement. If Stereosat had proceeded towards implementation, private sector corporations likely to consider participation with the government would be described as mature. For the purposes of this discussion, a mature corporation may be described as one established in its markets with a relatively secure level of earnings and a commitment to earnings growth through investment. Mature corporations attempt to minimize risks which may hamper a relatively steady growth in earnings. For this reason, the mature corporation attempts to reduce the uncertainty associated with any of the

factors of production or demand. Market studies are a manifestation of this desire; the corporation wants to be as certain as possible a market for the product exists before investing its capital. Examples of this are the recurrent requests by potential private sector investors in Landsat or Stereosat for the government to define its own market for imagery. That is, how much data over what period and at what price is the government going or willing to purchase. Taken to its logical extreme, the private sector would like to have a firm purchase commitment because that eliminates uncertainty about the revenues which would be derived from government purchases of data.

Revenues are determined by the price charged and the number of units sold. Traditional market analysis techniques often yield reasonable estimates of the number of units which could be sold. These market projections are often extrapolations based on sales of similar items. Some projection of expected Stereosat sales based on the Landsat sales listing are discussed below.

A more difficult problem is the price to be charged, and demand sensitivity to price. Economic theory says that the price charged for a product should reflect its value. Virtually everyone agrees that Stereosat imagery would be a valuable addition to existing data bases, that is, Stereosat imagery would be useful. The question remains, however, how much these users would have been willing to pay to obtain Stereosat imagery.

Stereosat imagery would be information, information that would be of value in a number of applications. The economic value of this information would be hard to determine. One example may reveal the complexity of the problem. Stereosat imagery would have supported non-renewable resource exploration in at least two ways, each of which could be considered as contributing to its value. First, Stereosat imagery would have provided

additional information about a particular area. Additional information has value. Second, Stereosat imagery would have provided a synoptic framework for organizing other data which may have led to additional information being extracted from this existing data. The value of Stereosat here would have been derived from other valuable information. Both of these uses of Stereosat imagery could have contributed to a higher probability of success in exploration. An onshore well today can cost millions of dollars. If Stereosat images could increase the probability of success even a few percent, those images would have significant value. The particular images which could be identified as having contributed to specific producing wells would have high value. The value attributed to success must be allocated across all images because the value of particular images cannot be determined a priori. Theoretically, the price to be charged for the images used in nonrenewable resource exploration should reflect their value in that application. In other applications, Stereosat images would have different value.

It is easy to discuss value in the abstract and argue for an economic pricing scheme. In fact, however, the ranges of applications where Stereosat images could be useful have only tentatively been identified. Potential users probably could not articulate the value of Stereosat images in their applications today any more than early Landsat users could foretell its potential use. Admittedly, almost a decade of experience with Landsat should make analogizing easier and somewhat more reliable. But, as was true with Landsat, the value of Stereosat images in the hands of users probably cannot be ascertained with confidence until after they have had an opportunity to use the images in their particular application.

The question, fundamentally, was whether there was enough confidence in the existence of a market for Stereosat images to attract investment, both

from the private sector and from government. Neither sector has been able to quantitatively assess the market. That large uncertainty, coupled with the emphasis on evolving an operational remote sensing system, has created a reluctance on the part of both the government and the private sector to invest in Stereosat.

This document was drafted and revised a number of times. Each revision attempted to accommodate the then current status of Stereosat as a program within NASA and the overall civil remote sensing program. The result is that some portions of the document reflect earlier ideas which are now inappropriate given the evolution of the Landsat system towards an operational system. These ideas are discussed here not for the current viability, but rather because they may be of use in moving towards an integrated civil remote sensing system.

SECTION I

INTRODUCTION

Stereosat[1] was a proposed satellite system whose purpose was to obtain worldwide cloud-free stereoscopic images of the Earth's land masses. Stereosat would provide for the first time a consistent data set covering the entire Earth, both in traditional photographic images and as digital computer compatible tapes (CCT's). Stereoscopic photo imagery is today used in a large number of applications including petroleum and mineral exploration, engineering geology and hydrology, photogrammetry, and other applications. Thus, the photographic image products from the Stereosat mission would have been readily integrable into an existing geosciences industry. Having the stereoscopic image data available in CCT form meant that this data could be computer merged with existing data bases such as Landsat and others. The technology for this computer image merging and the extraction of useful information from the merged data is in its infancy, and Stereosat would have encouraged its growth and development. See Appendix 1.

Some people both within and outside government have advocated a policy with respect to space remote sensing that where a readily identifiable segment of the private sector is the primary beneficiary of an activity, that sector should participate fully with the government in the cost of development and implementation of the particular project. This policy has been interpreted by

---

1 A detailed description of the Stereosat mission may be found in the Preliminary Stereosat Mission Description, JPL Report No. 720-33, prepared by the Jet Propulsion Laboratory (JPL) for the National Aeronautics and Space Administration (NASA), May 30, 1979, hereinafter referred to as the "Preliminary Mission Description." (JPL internal document.)

some to mean that the private sector should contribute to up front expenditures. The traditional mode of private sector involvement in space remote sensing has been as government contractors providing spacecraft systems, launch vehicles, and the like. In the Landsat series of satellites, the government has paid the cost of the satellite, launch, and continuing operations, and sells the data to individuals in the private sector for the cost of reproduction. Since the underlying rationale for those missions has primarily been scientific and proof of concept, this institutional model has been appropriate. Where the satellite system would be dedicated to an identifiable group in the private sector, this policy would mean that the beneficiaries would be expected to contribute to the implementation of the project, that is, the processors of the data, value added processors, and utimately the users.

Stereosat was the first space remote sensing mission which appeared to have a specifically identifiable private sector end user. Some segments of the government have also appeared to have an interest in obtaining Stereosat data. Although a number of private sector users have strongly advocated that NASA proceed to implement Stereosat, they acknowledge that the market for stereo imagery has been perceived as very uncertain. With this perception the private sector appeared reluctant to invest in space remote sensing up front. However, segments of the private sector expressed willingness to purchase the data once it becomes available. The problem presented to the government was twofold. First, the government had to determine whether Stereosat had net positive benefits to the United States, a question of value. If it were concluded by the government that implementing Stereosat was in the best interests of the United States, then the government would have to have created

an institutional structure which involved the private sector in implementing Stereosat.

This study examines two broad questions:

- What is the value of Stereosat? What is the social value and the social cost of having this stereoscopic data available to the country as a whole? And, what is the private value and the private cost of this data? A fundamental issue here is the potential market for the data products.
- What are the legal, economic, political, and institutional constraints which would impinge upon any potential joint private sector/government structure created to implement Stereosat?

The approach of this study has been to identify the issues within each of these questions which must be addressed prior to the federal government actually creating an institutional arrangement for joint private sector/government participation in Stereosat.

It should be noted at the outset that the scope of this study has, of necessity, been constrained by the main objective of identifying those issues which would have to be resolved prior to decision by the National Aeronautics and Space Administration (NASA) to proceed with any joint private sector/government participation in Stereosat. While this study had definite goals and objectives, and sought to answer the questions presented, the large degree of uncertainty surrounding this venture by government has resulted in the focus here being one of issues definition. No attempt has been made to undertake a complete analysis. The intent has been to examine some identified issues. Considerable research remains to be done to fully understand both the market for stereo imagery, and the advantages and disadvantages of those

institutional structures identified and others which may be proposed in the future.

This document reports studies undertaken at the Jet Propulsion Laboratory (JPL) in support of the NASA Earth Resources Observation Program. Within JPL the study represents an application to space related activities of skills which were developed to support primarily energy research programs. Within NASA the document is intended to make program managers aware of the types of nontechnical issues which would have to be addressed to implement Stereosat. The document is intended to be read by government policy makers, specifically within NASA, to assist them in interfacing with the private sector.

The report structure parallels the two questions discussed above. The first section examines the question of the "value" of Stereosat data to the private sector and the government. Since no accurate market data were available, the question of value is examined from the perspective of the user community and the perspective of the federal government. For Stereosat to be a viable mission, it must have "value", even if that "value" is only a subjective perception of positive net benefit.

The next section of the report is based on the following: assume that Stereosat will be implemented, what joint private sector/government institutional structures could be appropriate. Since one institutional structure could encompass the entire system, or different institutional structures could be appropriate for components of the total system, the Stereosat subsystems which may be independently organized are then discussed. Generic institutional structures and the influence of the market for stereo images on those structures are examined. Two case studies of specific concepts to implement Stereosat are discussed.

The third major section of the report discusses legal and institutional issues which may constrain the choice of institutional structure. Fourth, some existing institutional models are examined. The final section is an overall summary and attempts to draw some conclusion.

SECTION II

PERCEPTIONS OF VALUE

At any point in time there are many more projects which could be undertaken to the overall betterment of society than resources will allow. The problem is to choose those projects which are by some criteria "more valuable", "better" or a "higher priority." The selection of the criteria, which themselves change in response to changing social needs, determines the projects more likely to be undertaken than not. In the private sector, capital is generally allocated to projects having the greatest expected potential return on investment for a given risk, an economic efficiency criterion. The projects undertaken by government are generally those considered to advance the mission of the particular agency and the government as a whole. The budget process generally results in only the highest priority projects of each agency being funded. The government selection criteria are, thus, political ones based on public policy. It should be noted, however, that the government often also applies economic efficiency criteria in the budget process to select projects.

It should also be noted that value is different from cost. The cost of Stereosat is a function of the technology employed to provide the imagery. Value is the benefit derived from having the imagery available for use. Value is an elusive concept; it means different things to different people. An investor in Stereosat would like to know how user perceptions of value would be translated into willingness to pay for imagery. This information, however, is not available. Value and willingness to pay can, therefore, only be assessed qualitatively. One way to determine the value of Stereosat is to

examine the perspectives of persons and organizations who might participate in the implementation or be affected by it.

A. THE PERSPECTIVE OF THE USER COMMUNITY

The United States has for almost a decade been observing the earth's land surface from space with the Landsat series of satellites.

> "The three most important potential uses of the Landsat data identified so far correspond to three of the major problems confronting the world today. These are energy supplies, food production, and global large-scale environmental monitoring ...
>
> Landsat imagery also has proven to be a valuable tool when used in conjunction with other data sources for ... preparing base and geologic maps."[2]

Stereosat, as an adjunct to existing Landsat imagery, appears to have its greatest value in the search for oil and minerals, and in cartography.

1. Exploration Geology

In May 1976, a workshop was held in Flagstaff, Arizona, by predominantly industry geologists to answer the question, "What do the geology related industries want specifically from remote sensing?"[3] The highest priority recommendation was:

> "1. Worldwide stereoscopic coverage missions (Stereosat) ... for geological and structural interpretation and mapping."[4]

---

2 "Landsat-C," NASA Office of Public Affairs, Goddard Space Flight Center, Greenbelt, Maryland, at 2 (March 1978).

3 Frederick B. Henderson and Gordon A. Swann (eds.), Geological Remote Sensing From Space, Report of the Ad Hoc Geological Committee on Remote Sensing From Space with Recommendations for a Geosat Program, at vi (May 10-14, 1976), hereinafter referred to as the "Flagstaff Report."

4 Flagstaff Report, at 1-1.

This recommendation was based on an identification of geological parameters for oil, gas, and mineral exploration which are not available from Landsat imagery. The most forceful argument for having stereoscopic imaging was presented by the oil and gas exploration workshop.

> "A major deficiency in the present Landsat system is the lack of worldwide stereo coverage, because basic photogeologic mapping techniques depend on three dimensional perspective that stereoscopic images provide. Stereo perception is essential because most of the geological phenomena sought after are three-dimensional features that are incompletely and poorly displayed on the two-dimensional format of a single image ...
>
> When studied in stereo vision, the nature of many lineaments can be segregated into groups of faults, joints, indeterminate linear features. This is particularly significant if geological space remote sensing is going to be an effective tool for global geologic and tectonic studies."[5]

The mineral resources and engineering and environmental geology workshops also articulated a significant need for

> "... high resolution (10-meter) photographic and multispectral scanning sensors with worldwide stereoscopic coverage for geologic and structural mapping ..."[6]

2. Cartography

The cartographic user community has not yet articulated a need for stereoscopic imagery in an organized fashion similar to the exploration community. An indication of value may be the Request for Proposal (RFP) issued by the U.S. Geological Survey (USGS) to investigate the feasibility of an automated mapping satellite system (Mapsat).[7] The Mapsat RFP argues that

---

5 Flagstaff Report, at 3-7.

6 Flagstaff Report, at 5-24, for example.

7 U.S. Geological Survey, Request for Proposal No. 6398, "Feasibility Study for the Conceptual Design of an Automated Mapping Satellite System," October 15, 1979, hereinafter referred to as the "Mapsat RFP."

Landsat imagery would have greater utility

> "by finer spatial resolution, and by providing stereoscopic coverage from which terrain relief could be determined and correlated with the multispectral response from Landsat ...
> ... most applications require that the data be geographically located--mapped--with an accuracy approximately equivalent to the spatial resolution."[8]

While there appears to be a number of differences between the Stereosat sensor system and that proposed for Mapsat, the Mapsat stereo imaging requirements could possibly be met by modifications to Stereosat.

Once the question of technological capabilities is resolved, the inquiry becomes the size of the cartographic user community. Within the United States the U.S Geological Survey is probably the single largest user of remote sensed imagery for cartographic purposes. USGS purchased approximately one-third of the total U.S. government purchases of Landsat imagery over the period 1973-1978, but not all of this imagery was used for cartography. Government purchases were about one-third of total sales.[9]

The potential cartographic market worldwide is unknown. The Mapsat RFP specifies a data product aimed at use worldwide:

> "... a Mapsat image map published at 1:100,000-scale might well have accuracy comparable to that of a 1:50,000-scale line map which is standard throughout the world."[10]

---

8 Mapsat RFP, Section E, Specifications, at 1.

9 Data provided by the Earth Resources Observation Systems (EROS) Data Center, Sioux Falls, South Dakota.

10 Mapsat RFP, Section E, Specifications, at 2.

3. Stereo Satellite Data Product Market Assessment

One of the recommendations of the Flagstaff meeting industry geologists was the creation of an industry supported Geosat Committee

> "to pursue and espouse industry related geologic objectives within the framework of the ongoing space program."[11]

The Geosat Committee had its organizational meeting in the fall of 1976. In early spring 1977 the Geosat Committee formed a Stereosat Task Force to assess the potential market for stereo satellite imagery.[12] The Stereosat Task Force was formed to respond to a request by the federal government, members of Congress and the NASA Office of Applications, to determine "a formula for equitable industry sharing of the Stereosat program costs."[13] The Geosat Committee Stereosat Task Force Report was published in November 1978.

The Geosat Market Study first described a Stereosat data product designed to meet the needs of the geological industry. This data product encompassed five criteria: near term global coverage, stereo imagery, improved resolution, Landsat compatibility, and a synoptic view.[14]

The Geosat Committee data product description was the basis of two surveys of potential users. The first survey included Geosat Committee member companies, nonmember companies, government agencies, and ten experts in the

---

11 Flagstaff Report, at vi.

12 Letter to Dr. Anthony J. Calio, Associate Administrator for Space and Terrestrial Applications, NASA from Dr. Frederick B. Henderson, President, the Geosat Committee, dated May 9, 1978.

13 Frederick B. Henderson, Paul M. Maughan and Frederick L. Hoffman, Stereo Satellite Data Product Market Assessment, November, 1978, at 1-1, hereinafter referred to as the "Geosat Market Study."

14 Geosat Market Study, at 3-1.

mineral and oil industry familiar with remote sensing technology.[15] The experts were asked to provide opinions about the potential global market.[16] The surveyed organizations were sent a letter describing the Stereosat data product and a questionnaire which asked each of them to estimate his quantitative prospective purchases over a three-year period based on an assumed product price of $450 per stereo pair of images.[17]

A follow-up survey of some major oil and mineral companies and a few government agencies attempted to elicit further comments on the potential market for Stereosat images. Major Geosat Committee member companies and a few government agencies were solicited for Letters of Interest to purchase Stereosat data products. Fourteen responses were obtained.[18]

These surveys formed the basis of a quantitative estimate of the potential market for Stereosat images. The first step in the analysis was to fix a price for the data product.

> "The data product price of $450 was based on the Stereosat Task Force's preliminary estimate of the value of the data product relative to Stereoscopic aerial photography and Landsat imagery on a per square kilometer basis. Figures used by the Task Force ranged from $5.00 per square mile ($1.93 per square kilometer) for stereo aerial photography to $0.02 per square mile ($0.01 per square kilometer) for an average Landsat image data product. The $0.12 per square kilometer was a compromise by the Task Force members."[19]

Based on quantitative information from 39 Geosat Committee industry members, and based on Landsat sales history, the market study estimated a

---

15 Geosat Market Study, at 3-1.

16 Geosat Market Study, at 4-1.

17 Geosat Market Study, at 4-1; Appendix C.

18 Geosat Market Study, at 4-4.

19 Geosat Market Study, at 6-1.

United States industrial demand of approximately 139.5 million square kilometers of coverage over the three-year life of Stereosat, and a corresponding global market, including the United States, of about 474.4 million square kilometers. The United States industrial demand would, therefore, be about 39,000 data products and worldwide demand 132,000 data products.[20]

At the time the market study was undertaken, Stereosat was expected to cost about $100 million with additional operating and maintenance expenses of about $10 million over the three-year life of the satellite. Spreading these costs over the global demand resulted in a product price of $835 per stereo pair.[21]

> "Based on the $450 assumed value, the [illegible]385 per product cost differential that must be supplied either through government support or increased prices."[22]

The global market comprised of industry, state, local and federal government, individuals, and foreign entities was estimated to be about $59 million. The United States industrial sector was to account for about $17 million of this total market.[23]

The policy conclusion reached by the Geosat market study was that

> "... the amount needed to underwrite the Stereosat mission approximates a 1/2 user ratio, 1/2 government (where the user support derives from product sales and government funds are appropriated program funds.)"[24]

---

20 Geosat Market Study, Table 5.2, at 5-5.

21 Geosat Market Study, at 6-2.

22 Ibid.

23 Geosat Market Study, at 6-1.

24 Geosat Market Study, at 1-2.

Professor Leonard J. Parsons of the College of Industrial Management, Georgia Institute of Technology, reviewed the Geosat Market Study and concluded:

> "The Geosat Report was a useful preliminary market assessment for Stereosat. However, the estimated global requirements for stereo data products may not even be a good ballpark figure."25

Some of the factors which led Professor Parsons to his conclusion include:

(1) The disproportionate importance of a relatively few potential users of the Stereosat data, that is, a relatively few users are expected to account for a large proportion of sales.

(2) The reliability of survey estimates of market demand. In this case, it is questionable whether the user knows or is willing to reveal his demand for Stereosat images, and if an estimate was given, whether that estimated demand will be true demand when the images are available.

(3) The assumed relationship between Landsat and Stereosat users.

(4) The assumed relationship between the historic Landsat sales history and projected Stereosat sales; and the assumed relationship between Geosat industrial companies and the projected world market based on that sales history. The worldwide market is estimated to be a multiple of the Geosat Committee member industrial companies.

(5) The expected sales profile of Stereosat should cumulatively be S-shaped, that is, slow sales initially while the product is being evaluated, a rapid sales growth once usefulness is demonstrated, and a slowing of sales as users have purchased a complete set of Stereosat images. Since Landsat provides repetitive coverage, some users continue to purchase its images.

---

25 See, Appendix 1.

(6) The lack of analysis of the sensitivity of demand to price.

Professor Parsons' evaluation is presented in Appendix 1.

4. Summary

The oil and mineral exploration industry and the cartographic community have articulated a need for stereoscopic imagery in their particular application. This "need" seems to be at the level of "it would help and it would be nice to have." In areas where stereo imagery is essential, it is currently obtained via aircraft overflight. In many parts of the world it is difficult or impossible to get permission to overfly. Stereosat would provide worldwide coverage not readily obtainable via another mode.

The fundamental question is if these user communities "need" Stereosat data, how much are they willing to pay to obtain it. Put another way, if the images are as valuable as these users claim, are they willing to contribute capital upfront sufficient to procure, launch, and operate Stereosat? It appears they are not.

It should be noted that the COMSAT General Corporation undertook a market study to determine the viability of investing in Stereosat. This market study was proprietary to the company.[26]

B. THE PERSPECTIVE OF THE U.S. GOVERNMENT

1. National Aeronautics and Space Administration

The idea for Stereosat was presented to NASA in July 1976.[27] Prelim-

---

26 Personal communication, Dr. Paul M. Maughan, Director, Earth Sensing Systems, COMSAT General Corporation, November 1979.

27 Preliminary Mission Description, at 1-2.

inary studies were undertaken in late 1976 and early 1977 in anticipation of a New Project Start[28] in Fiscal Year 1979 (FY'79). NASA did not go forward in its FY'79 budget proposal with Stereosat as a New Project Start.

During the FY'79 budget hearings in Congress, members of the user community testified in support of Stereosat. The result was a supplemental appropriation of $500,000 in FY'79 to support a mission study. In making these study monies available, members of the House and Senate Subcommittees on Space urged that the Geosat Committee investigate the feasibility of user participation in the development and funding of Stereosat.[29,30]

In early 1978 a mission study was commenced with the objective of a New Project Start in FY'80. (NASA did not include Stereosat in its FY'80 budget proposal.) The mission study continued through FY'79. The studies in FY'79 included an examination of potential roles for private sector participation in Stereosat; this report documents the results.

Within NASA there is still considerable interest in Stereosat. In the current times of tight budgets, the inability to articulate a clear, private sector involvement in Stereosat, specifically private investment, was probably

---

28 A 'New Project Start' means the project will from that point be a live item in the Federal Budget. It is authority for major system procurements. The project can still be terminated or altered, but the designation 'New Project Start' usually means that NASA intends to see the project through to completion.

29 Operational Remote Sensing Legislation: Hearings on S.663 and S.875 before the Subcommittee on Science, Technology, and Space of the Senate Committee on Commerce, Science and Transportation, 96th Congress, First Session at 202 (April 9 and 11, 1979) (statement of Frederick B. Henderson III, President of the Geosat Committee), hereinafter referred to as 'S.663/875, April 1979.'

30 This was the impetus for the Geosat Market Study.

a major factor in NASA not going forward for a New Project Start. Other influences, to be discussed below, were also important.

In summary, the mission objectives of Stereosat remain of interest within NASA. Because Stereosat has capabilities which are perceived by some as being commercially viable, NASA was placed in an awkward position. NASA was, in effect, considering a mission going well beyond its research and development charter. Since at that time basic policy determination on an operational land remote sensing system had not been made, NASA was the logical agency to handle Stereosat. With the designation of the National Oceanic and Atmospheric Administration (NOAA) as the agency responsible for operational land remote sensing systems[31], future decisions about Stereosat in its present configuration will be made in the context of its role as an adjunct to the evolving operational remote sensing system.

2. Interagency Task Force on Private Sector Involvement in Civil Space Remote Sensing

In Presidential Directive/NSC-42, entitled Civil and Further National Space Policy, issued October 10, 1978, the President directed NASA and NOAA to investigate potential private sector roles in the operation of civil remote sensing systems.[32]

> "5. Private Sector Involvement. Under the joint chairmanship of Commerce and NASA, along with other appropriate agencies, a plan of action will be prepared by February 1, 1979, on how to encourage private investment and direct participation in the establishment and operations of civil remote sensing systems. NASA and Commerce jointly will be the contacts for the private sector on this matter

---

31 Presidential Directive/NSC-54, Civil Operational Remote Sensing, November 16, 1979, hereinafter referred to as 'PD-54.'

32 Presidential Directive/NSC-42, Civil and Further National Space Policy, October 10, 1978, hereinafter referred to as 'PD-42.'

and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action.(U)"[33]

The focus of the Private Sector Involvement Study (PSIS) was "the potential role of the private sector in the ownership and operation of space remote sensing systems as a commercial enterprise."[34] PSIS specifically considered Stereosat and concluded

> "For the Stereosat system, the government support required would be $40M/year. There has been little interest displayed by government agencies in obtaining operational data from a new Stereosat system. Therefore, most of the government support would be as a subsidy."[35]

Stereosat was thus viewed as not commercially viable without significant government participation. The private market estimate used to reach this conclusion was that provided by the Geosat Market Study.

The general conclusion reached in the PSIS for the Landsat system is, by implication, appropriate for Stereosat.

> "...it is too early to select specific options for conversion of the space and ground segments of the Landsat system to private ownership. This is not to say that it is too early for private participation but that it is too early to constrain the alternatives that might be put forward by the private sector.
>
> It appears that the private sector is only now beginning to develop concrete proposals for major investment in systems, that thinking among different firms with regard to such proposals differs very substantially, that the shape of future systems is not sufficiently defined, that current government studies of the possible integration of systems will need extended consideration, that the technical and market potential of even Landsat D/D' is yet to be learned--that for all these and additional reasons it would be best to avoid selection of a single option at this time.

---

33 PD-42. Note: The due date was later changed to June 15, 1979 to integrate the Private Sector Involvement Study (PSIS) with a related Integrated Remote Sensing Systems Study (IRS3).

34 Interagency Task Force on Private Sector Involvement in Civil Space Remote Sensing, Private Sector Involvement in Civil Space Remote Sensing 2 (June 15, 1979), hereinafter referred to as 'PSIS'.

35 PSIS, at 16.

Instead, some time should be allowed to permit the private sector to further develop its thinking and offer a variety of approaches which may be evaluated in terms of the public interest. If the government were to select a single option at this time, it is likely that only one or two proposals, if any, could be expected from the private sector for implementing that particular option. Other equally or more advantageous proposals, current or potential, would be excluded, even though there would be other interested firms, because their interest would be associated with different options.

In order to stimulate the development and submission of all proposals which might be in the public interest, it would appear appropriate to request proposals addressed to general criteria rather than to a selected system configuration or particular institutional approach."[36]

Some criteria for judging private sector proposals were articulated in the PSIS.

"In general, proposals for private sector initiatives should be judged on their relative merit in meeting objectives such as the following:

1. The extent to which they are generally favorable to the government and the economy, i.e., the extent to which they reduce the burden of government costs for the service.
2. The extent to which they reliably meet government and private sector needs.
3. The extent to which they are cost effective in meeting public/private needs.
4. The prospects for developing commercial markets for data and services.
5. The feasibility and extent of government support and involvement required.
6. The assurance that continuity of service to meet government requirements would be guaranteed.
7. Their amenability to the necessary government presence in and regulation of the system.
8. Compatibility with evolving domestic policy on remote sensing (including the many decisions which may follow from the study of integrated remote sensing systems).
9. Their compatibility with evolving international policies and commitment.
10. The extent to which they would accelerate private investment and participation (including the advantageous use of existing or planned government facilities.)

---

36 PSIS, at 28.

11. The extent to which they preserve or advance U.S. leadership in space remote sensing."[37]

In summary, the PSIS concluded that it may be too early to determine an appropriate joint private sector/government institutional structure for either Stereosat or the current Landsat system. PSIS did conclude that there are significant opportunities for private sector involvement in the future and recommended a plan of government action to enhance those opportunities.

3. Evolving an Operational Remote Sensing System

As the benefits of satellite remote sensing have been demonstrated using the Landsat system, a user community throughout the world has developed. The growth and development of this nascent industry is dependent to a great extent on the continued availability of a steady flow of satellite remotely sensed data. "Many potential users refrain from making necessary investments for the use of remotely sensed data because they fear the experimental system will be abandoned by the government."[38] This concern has led to a desire for a commitment on the part of the federal government to an operational remote sensing system.

Early legislative approaches to establishing an operational remote sensing system took the form of Senate Bill 657, Earth Resources and Environmental Information System, introduced in the 95th Congress, First Session; Senate Bill 3589, Earth Data and Information Service Act of 1978, and Senate Bill 3625, Earth Resources Information Satellite Act of 1979, both

---

37 PSIS, at 29.

38 Arlen J. Large, "NASA Finds Many Buyers for Satellite Pictures and Plans New, More Revealing Landsats in 1980's," Wall Street Journal, April 5, 1979, at 1.

introduced in the 95th Congress, Second Session. Hearings were held on S.657 only.

> "At that time administration witnesses opposed passage because, in their view, the legislation was premature. Dr. Frank Press, Director, Office of Science and Technology, Office of the President testified that a Cabinet-level group was assembled to consider the issue and make recommendations."[39,40]

In June 1978, the President issued Presidential Directive/NSC-37, entitled "National Space Policy,"[41] wherein he stated the space principle:

> "The United States will develop and operate on a global basis active and passive remote sensing operations in support of national objectives."[42]

PD-37 also created a National Security Council (NSC) Policy Review Committee (PRC) to formulate a civil space policy within the following guidelines:

> "The United States will encourage domestic commercial exploitation of space capabilities and systems for economic benefit and to promote the technological position of the United States; however, all United States earth-oriented remote sensing satellites will require United States government authorization and supervision or regulation.
>
> Advances in earth imaging from space will be permitted under controls and when such needs are justified and assessed in relation to civil benefits, national security, and foreign policy. Controls, as appropriate, on other forms of remote earth sensing will be established.
>
> Data and results from the civil space programs will be provided the widest practical dissemination to improve the condition of human beings on earth and to provide improved space services for the United States and other nations of the world."[43]

---

39 S.663/875, April 1979, at 1 (Opening Statement of Senator Adlai E. Stevenson).

40 The 'Cabinet-level group' is the NSC Policy Review Committee (Space).

41 Presidential Directive/NSC-37, National Space Policy, June 20, 1978, hereinafter referred to as 'PD-37'.

42 White House Press Release (Description of a Presidential Directive on National Space Policy), June 20, 1978.

43 Ibid.

The studies undertaken by PRC (Space) led the President to announce a U.S. Civil Space Policy in October 1978.[44] At this time the President committed the United States to "continuity of data" from the Landsat system.

> "Remote sensing systems.--Since 1972 the United States has conducted experimental civil remote sensing through Landsat satellites. There are many successful applications and users, including Federal departments, other nations, a number of States, and a growing number of commercial organizations. The United States will continue to provide data from the developmental Landsat program for all classes of users. Operational uses of data from the experimental system will continue to be made by public, private, and international users. Specific details and configurations of the Landsat system and its management and organizational factors will evolve over the next several years to arrive at the appropriate technology mix, test organizational arrangements, and develop the potential to involve the private sector."[45]

The President also made a firm commitment to involve the private sector in civil remote sensing systems.

> "The private sector.--Along with other appropriate agencies, NASA and Commerce will prepare a plan of action on how to encourage private investment and direct participation in civil remote sensing systems. NASA and Commerce will be the contacts for the private sector on this matter and will analyze proposals received before submitting to the Policy Review Committee (Space) for consideration and action."[46]

Although these two policy decisions had been made, evolving an institutional structure to implement them was yet to be undertaken.

Two bills introduced in the Senate subsequent to PD-42 attempted to legislatively create institutional structures for an operational remote sensing system to provide this continuity. Senate Bill 663, the Earth Data and Information Service Act of 1979, 96th Congress, First Session, would have created an Earth Data and Information Service as an agency of the federal

---

44 PD-42.

45 Fact Sheet, U.S. Civil Space Policy, the White House, October 11, 1978.

46 Ibid.

government within NASA. This bill was basically a "holding action" to provide for the acquisition and dissemination of Earth resources data by the federal government until appropriate institutional mechanisms were investigated so the government could reach a decision as to whether and how this activity should be transferred to the private sector. The service was given a maximum term of seven years.

Senate Bill 875, the Earth Resources Information Corporation Act of 1979, 96th Congress, First Session, would create a "for profit" private corporation to establish and operate a commercial Earth Resources information service. The federal government would act as the incorporator and retain 20-percent ownership of the shares. In other respects, the Corporation resembles the traditional private corporation. Both of these bills are discussed in detail in Appendix 2.

Hearings were held on both bills by the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science, and Transportation on April 9 and 11, 1979 and again on July 31, 1979. Administration witnesses at those hearings again reiterated their view that legislation was premature.

> "My own view, having looked at the bill, is that it asks for a commitment to a very specific form of management and operational status which we believe is premature in the light of all the ferment that's going on--the ferment in the form of a new private sector interest for commercialization of remote sensing; the renewed and expanded interest by domestic agencies putting up their own budgetary funds for remote-sensing applications; the expanded foreign interest in remote sensing; the review by NASA and the Department of Commerce, which is now in a mature stage, for finding means to encourage private sector involvement—for all of these reasons, especially because the technology is still evolving, we feel that to make a commitment at this time to a very specific form of management would be premature."[47]

---

47 S.663/875, April 1979, at 49 (Statement of Dr. Frank Press, Director, Office of Science and Technology, Office of the President).

The administration witness stated that, "the administration is committed to an operational remote sensing system,"[48] as evidenced by PD-42, but that more study was required to create an appropriate institutional structure which would involve the private sector.

These bills are still pending before the Senate Subcommittee on Science, Technology and Space.

In the period after announcement of PD-42, October 1978, the Administration continued to study options for assuring the "continuity of data" from Landsat. On November 15, 1979, the President issued Presidential Directive/NSC-54, entitled "Civil Operational Remote Sensing," assigning management responsibility for civil operational land remote sensing activities to the National Oceanic and Atmospheric Administration (NOAA). NOAA was directed to prepare a transition plan by June 1, 1980, and to seek ways to further involve the private sector in civil land remote sensing.

> "Commerce's initial responsibility--in coordination with other appropriate agencies--will be to develop a time-phased transition plan covering: (1) a Program Board (discussed below); (2) organization for management and regulation; (3) system financing including pricing policies for the users sharing of costs; (4) technical programs; (5) establishment of private and international participation; (6) identification of facilities (including the EROS data center), hardware, and personnel that should be transferred; and (7) identification of actions such as executive orders and legislation required.
>
> b. Private Sector Involvement. Our goal is the eventual operation by the private sector of our civil land remote sensing activities. Commerce will budget for further work in FY 1981 to seek ways to enhance private sector opportunities (e.g., joint venture with industry, a quasi-government corporation, leasing, etc.). Commerce will be the contact for private industry on this matter and with the Program Board will analyze any proposals received prior to submitting policy issues to the Policy Review Committee (Space) for consideration and action."[49]

---

48 Ibid.

49 PD-54.

4. Summary

The events synopsized above reflect a movement towards implementation of an operational remote sensing system. Stereosat would enhance the data already being obtained or that which will be received once the operational system is implemented. It is reasonable to infer, however, that Stereosat is viewed as a complement to the operational system and not an integral component. Given the appropriate emphasis on implementing the operational system which serves a larger user community than Stereosat, Stereosat is not as high a priority within the government as the operational system. This is not to say, however, that Stereosat has no value. Rather, it is to defer a decision on a government commitment to Stereosat until it can be evaluated in the context of an operational remote sensing system.

C. SUMMARY

It is clear that both government and the private sector feel the data which would be obtained by Stereosat has value. Both the private sector and the government agree that Stereosat has private value; that is, the information obtained by using Stereosat imagery would benefit a number of applications in the private sector. Government appears to want the private sector to recognize the private value of Stereosat and contribute to its implementation accordingly. The private sector acknowledges that Stereosat has private value, but appears unable at present to accommodate the market uncertainty associated with the perceived value.

The Government has acknowledged that value would accrue to society through increased private sector participation in civil remote sensing programs, including Stereosat. Social value would also accrue through use of Stereosat imagery in government applications. The social value which would

accrue to the United States from Stereosat as a research and development activity has not been articulated by either the private sector or government.

A number of components of the value of Stereosat have been identified. None by itself seems sufficient to justify proceeding to implement Stereosat. Taken together, the various statements make the value of Stereosat seem apparent. There is, however, no unity of force sufficient to lead to implementation. The perceived value remains ethereal.

SECTION III

INSTITUTIONAL STRUCTURES FOR JOINT PRIVATE SECTOR/ GOVERNMENT PARTICIPATION IN STEREOSAT

A. INTRODUCTION

In examining both the private sector and the federal government, it is readily apparent that a large and diverse number of organizational models are available, given the goals and objectives to be achieved by the institutional structure which was created. For example, within the government there exists the Airport and Airways Development Fund which is designated monies collected primarily from fuel taxes and user charges on the aviation community. Under the enabling legislation, these funds must be returned to the aviation sector by being spent on improvements to air transportation facilities. This is an example of a public trust fund.

An organization which involves both the government and the private sector is the Communications Satellite Corporation (COMSAT). COMSAT was created by Congress as a private corporation with the U.S. monopoly in the global commercial communications system, INTELSAT[50]. Once COMSAT was created it was soon permitted to expand into the domestic and maritime communications satellite business. COMSAT was at the time of its creation a "chosen instrument", that is, an entity specifically created to achieve a particular goal. Today COMSAT is a private sector corporation competing for business activities to provide a return to its investor stockholders. It still enjoys

---

50 Communications Satellite Act of 1962, 47 U.S.C. 701 et. seq., Pub. L. No. 87-624, 76 Stat. 419 (1962).

a monopoly in the international communications arena, but must compete competitively in the domestic communications and maritime satellite business and other ventures. Through a recent acquisition it hopes to use satellite communications systems in environmental monitoring.

A traditional electric utility is an example of a regulated monopoly. The utility raises capital funds which it invests in electricity production and distribution facilities. It charges for electricity and makes a rate of return on this capital investment. It would be very inefficient to have multiple electrical services in any given area, thus a monopoly is a reasonable form of organization, that is, electrical distribution is a natural monopoly. Utilities are normally regulated by a state Public Utilities Commission (PUC) which sets an allowable return on investment. Rate-of-return monopoly regulation has the undesirable characteristic of creating incentives for the regulated firm to incur higher costs than necessary in the short run, and over the long run to retard the introduction of cost saving technology, thereby maintaining higher costs. Since rate-of-return regulation limits profits to a fixed percentage of invested capital, the regulated firm can increase profits only by increasing its capital, the rate base.

The domestic communications satellite business is an example of regulated competitive entities. In the domestic communications business there are a number of private sector organizations which build satellites and provide communication services to the private sector and the federal government. They compete for customers and provide the service at a cost less than or equal to that of their competitors. Participants in domestic communication satellites are classified as common carriers and are subject to regulation by the Federal Communications Commission (FCC). These organizations must obtain a license

from the FCC to provide the service, and must also obtain approval for the prices, that is the cost of service, to be charged to the users.

Each of the above institutional structures is an example of an actual organizational entity wherein there are varying degrees of private sector and government involvement. There are, in fact, many other ways in which the private sector and the government jointly participate in activities. For example, where an activity has the indication of an adequate return on investment, but the technology is relatively uncertain, the government may guarantee loans provided by private sector financial institutions to the entity undertaking the risky activity. An example of this is the geothermal loan guarantee program, wherein the government guarantees loans provided by private financial institutions to builders of geothermal power plants.

This brief survey demonstrates that the government has in the past responded to the needs of its programs by creating a variety of institutional structures which include private sector participation. The question here is the joint private sector/government institutional structures most appropriate for Stereosat. Before the question can be answered, an analytic methodology must be discussed and the goals, objectives and characteristics of the Stereosat mission must be analyzed.

B. THE IMPACT OF THE STEREOSAT SYSTEM CONFIGURATION ON INSTITUTIONAL STRUCTURE

Before examining the overall Stereosat system, a brief discussion of some aspects of the theory of monopolies is appropriate. Monopoly power within an industry is generally defined as the power to control price or to exclude competition.[51] A monopolist is a seller who can change the market price for

---

51 L. Sullivan, Handbook of the Law of Antitrust, Section 9 (1977).

his product by changing the amount he sells.[52]

Certain kinds of goods and services have been subjected to government regulation because they share common economic traits. These are the "natural monopolies," examples of which include electric power transmission and distribution, natural gas distribution, and communications. The essence of the natural monopoly is that it would be illogical to have multiple competing producers for a product or service where the economies of scale and cost effectiveness are most appropriately captured by a single firm. For example, it is much more efficient to have a single telephone company serving a city than to have more than one. To have more than one telephone service would require duplicate facilities and higher costs to consumers.

The thrust of public policy towards enterprises acting as producers and sellers has been to enhance competition and prevent monopoly. Implementation of this policy for natural monopolies would theoretically be to restrict the monopoly to that arena of productive activity which has the appropriate economic characteristics, discussed above. In actuality, however, monopoly has been allowed to a greater extent than is necessary. For example, electric utility companies have enjoyed monopolies of both production and distribution of electricity. Only the distribution network is a true natural monopoly. There is no reason to restrict competition in the production of electricity. Any group of investors should be able to build a power plant and sell its electricity to that electricity distributor willing to offer the best price. Allowing and forcing the distributor, the natural monopolist, to purchase

---

52 R. Posner, Antitrust Law, 8 (1976).

power at the market price yields the greatest welfare to the ultimate consumers.[53]

A traditional regulated monopolist, like a utility, has an incentive to expand into related areas to increase his earnings. Since his return on investment is a regulated percentage of his invested capital, the only way he has to increase his return is to have a larger rate base. To get the larger rate base, the monopolist uses his cash flow to cross subsidize his expansion.[54] It is clear, theoretically, that to prevent this happening, public policy should allow a monopoly only in that portion of the productive activity which is a natural monopoly.

To analyze potential institutional structures for implementing Stereosat, it is appropriate to conceptualize the system as having three components: the spacecraft, including all required prelaunch, launch and station acquisition activities; the downlink, that is, the ground receiving station for the raw data; and data processors, one or multiple. See Figure 1. Various institutional structures may be appropriate for implementing a particular subsystem.

Spacecraft

The objective of the Stereosat mission was to collect a worldwide data set of stereo images. The data was to be collected to specification by a single spacecraft over a three-year period. As discussed above, the market for images appears insufficient to support even a single commercial enterprise

---

53 This example was provided by Professor William F. Baxter, Stanford Law School.

54 This is known in the economic literature as the Averch-Johnson effect. H. Averch and L. L. Johnson, "Behavior of the Firm Under Regulation," 52 American Economic Review 1053 (December 1962).

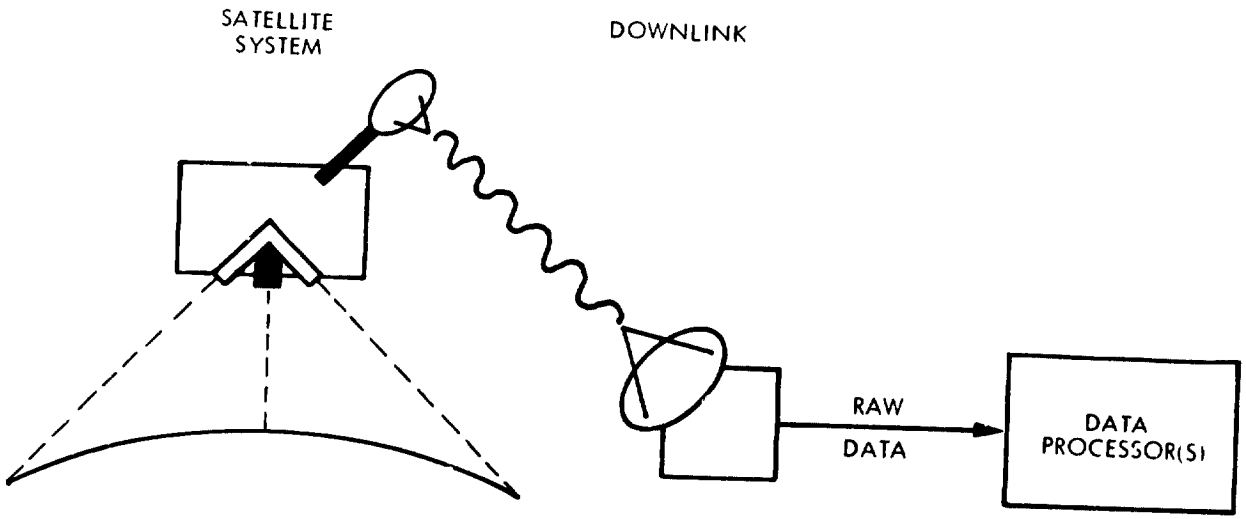


Figure 1. Components of Stereosat System

for the entire system. Thus, the spacecraft system has many of the attributes of a natural monopoly. The government could provide this portion of the overall system, or could invite private sector participation. In inviting private sector participation in the spacecraft system, the exclusive franchise, that is, the monopoly, should theoretically be restricted to that portion of the system which is a natural monopoly. In this case for the reasons discussed above, the private sector participant in the spacecraft system should theoretically be barred from participating in other portions of the system. There may be noneconomic reasons for not creating this bar. For example, to induce private sector participation, it may be desirable to allow one firm to own and operate the entire system.

Downlink

If the market for the images were sufficient to support multiple processors, there would be no reason for the government to participate in the downlink. Once the spacecraft is on station, whether launched by the government or some joint private sector/government enterprise, any private sector entity wishing to enter the market for stereo images, for their own use or to sell to others, could receive data from the spacecraft. The spacecraft operator would charge a fee for the data.

It is not clear whether the market for images would be sufficient to allow an acceptable return on an investment just in the downlink and the processing facility. It may be reasonable for the natural monopoly of the spacecraft system to encompass the downlink as well. The issues discussed above would then be applicable.

Data Processor

The market for stereo images might have been sufficient to support at least a single data processor on an all commercial basis. The required

investment, given that the spacecraft and the downlink existed in some form, would be considerably less. Therefore, the revenues required to garner an acceptable return would have been less, and the market may have been able to provide them. If the market was larger, multiple processors may be supported. Thus, the data processing might have been a competitive activity not requiring government participation.

In the event the market was inadequate to support a commercial venture and government participation was required, the data processing does not have many characteristics of a natural monopoly. The government might have participated in a number of institutional structures, but it need not necessarily have created a monopoly. It should be noted that a transient monopoly could have been created until the market was sufficiently developed to support a commercial venture.

Since the data processing does not have characteristics of a natural monopoly, the participants in this activity could be different from the entity who enjoys the spacecraft or spacecraft and downlink natural monopoly. It is reasonable to expect that the data processing activity would attract private sector participants from the established information systems industry and the geosciences industry.

Summary

The above discussion identified some basic public policy objectives which could have influenced the implementation of Stereosat. These public policy objectives were two: allowing a monopoly to exist only to the extent that it is a natural monopoly, and prohibiting the monopolist from participating in the competitive, that is non-natural monopoly, areas. A number of institutional structures would allow joint private sector/government participation and meet these public policy objectives. The final choice of

institutional structure would have reflected a number of public policy objectives, including those discussed here. The spectrum of potential institutional structures is discussed below.

C. TYPES OF INSTITUTIONAL STRUCTURES

Given the public policy objectives discussed above, the fundamental question becomes what type of institutional structure was appropriate to achieve the goal of implementing Stereosat. At the one extreme is the traditional government funded research and development model of a space venture. The government would provide all of the funding for the project, would procure the necessary technical expertise, would undoubtedly purchase components like the boosters and the spacecraft from the private sector, do the preliminary processing on the data once received on the earth, and disseminate that data to the private sector. This is the traditional government mode of doing business in space. The private sector would be an ultimate user of the data, purchasing it for the cost of reproduction analogous to the Landsat experience. The current government policy of fostering private sector participation in space ventures may have precluded implementation of Stereosat as an all government venture.

At the other extreme is a total private sector venture which would have been the first of its kind in space. Under this scenario, one or more private sector entities would invest sufficient capital to procure the spacecraft, the launch, and carry out the implementation of the mission. This entity or entities would build the ground data processing facility and sell the data to users. The private sector entity would of course be constrained by the public policy issues discussed above, but for the purposes of the discussion of the type of institutional structures which may be created, the concern here is

primarily implementation rather than other types of binding constraints to be discussed below. In the all private sector scenario the price to the user must be sufficient to guarantee an adequate return on the investment in the entire system.

Between these two extremes exist many types of institutional structures which would involve varying degrees of joint private sector/government participation. For this analysis it is convenient to view the various types of organizations as existing on a continuum ranging from all government activities on the one hand, to all private sector activities on the other, with the hybrid types of organizations in between. See Figure 2. It should be noted that the types of organizations hereinafter discussed are merely examples and not an exhaustive set of options. Specific organizations are discussed in the following paragraphs.

Private Sector Ownership of Subsystems

To encourage private sector ownership of subsystems of Stereosat, the government could have announced its intention to proceed with implementation and ask private sector entities to make proposals for investing in various subsystems. The private sector entities would have had to make an assessment of the potential return on investment from participating in a subsystem vis-a-vis other investments of its capital. The government would have had to evaluate each proposal and select the one or several which met its goals and objectives.

This institutional structure has been shown near the all government option because the government would have had to implement portions of Stereosat. The smaller the required private investment, the easier the private sector participant(s) earn a return.

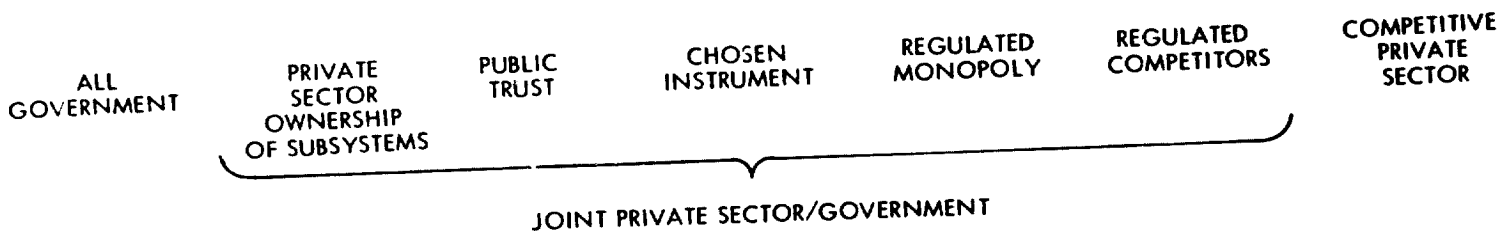


Figure 2. Continuum of Potential Institutional Structures

Public Trust

One of the factors influencing potential users' decisions to commit to up front investment was uncertainty about the usefulness of the Stereosat product, the stereo images, in their own analytic methodology. This user uncertainty generated market uncertainty. The government could have used a trust fund to subsidize the learning curve on the use of the data and, consequently, market development. Here the government would have budgeted for and proceeded with Stereosat as an all government activity. The monies would have been appropriated into a trust. One or more private sector entities would have been invited to implement Stereosat using the trust fund monies. For the implementation of Stereosat, these organizations would have earned a fee as a government contractor. Stereosat, in its entirety or subsystems, would have become a private sector activity when the cost of the purchased segment was paid into the trust fund, a buy-out.

This institutional structure would have encouraged the private sector to develop a market for the images and transfer all of Stereosat to private ownership. The government would have subsidized the private sector's education about the value of the stereo images. Here the private sector would have implemented Stereosat as a traditional investment activity but initially using government money. The system operators would have been encouraged to develop the system in a way to make it attractive for future private sector investment. The government, however, must have operated in a "worst case" fashion in that it must have budgeted Stereosat as an all government activity since it had no a priori knowledge of how much revenue would be returned to the government.

Chosen Instrument

When the United States became a participant in the global communications system, INTELSAT, Congress created the Communications Satellite Corporation, (COMSAT), to act as the sole U.S. representative. COMSAT was the "chosen instrument" to implement government policy.

For Stereosat Congress could have created a new organizational entity or selected an existing one to implement the mission. This organization could have been a public corporation, a private corporation, a governmental agency, or any of a number of other types of organizations. Legislative attempts to do this are discussed above.

The difference between the international communications market and the market for stereo images is perceived certainty. Revenues to COMSAT were a certainty; it provided improved services in a known market. Investors could readily be attracted to purchase the stock of the corporation. The market for stereo images is an uncertain new market and there is no guarantee that a private sector entity would survive; government subsidy would still have been required.

Regulated Monopoly

If the market for stereo images had been sufficient to support a single private sector entity, the government could have selected that participant, either by a competitive selection process or as a response to an unsolicited proposal. The government would have regulated this monopolist similar to the way utilities are regulated.

Regulated Competitors

Portions of the Stereosat system were similar to the domestic communications satellite business. The government would have been responsible for regulating the private sector competitors to ensure that the service provided

was consistent with government policies, for example, ensuring free access to the data. Government intrusion into the operation of the market would have been minimized. For competitors to have existed, however, the market for stereo images would have to have been significant.

Summary

There were a number of institutional structures which might have been appropriate to implement Stereosat. Each institutional arrangement has attributes which are attractive to the government and the private sector. The problem was how to design an appropriate institutional structure for implementing Stereosat or how to select an existing model. To make this selection, the government and the private sector must have had an analytic framework for comparing the attributes of the various proposals. Some of these issues are discussed below.

D. MARKET SIZE INFLUENCE ON INSTITUTIONAL STRUCTURE

One of the significant issues was the criteria by which the government would make a decision on the type of institutional structure to be proposed to implement Stereosat. A considerable number of issues are yet to be discussed; however, there is a significant underlying consideration which would have influenced to a great extent the options which the government might have pursued. Stereosat from a technological perspective was a relatively certain mission, that is, the technological risk, while not zero, was relatively small as contrasted with other types of space activities where the technological risk is significant. As is discussed above, one of the objectives of the Stereosat mission was to cause the private sector to provide capital funds to the project up front. It was not clear that this objective could have been achieved. The willingness of the private sector to invest capital funds is a

function of their perceived ability to garner a return on their investment. They also are willing to assume only certain types of risk, those traditionally associated with new business ventures. The private sector is, by and large, not willing to undertake large technological or market uncertainty risk where that market risk is a function of a commercially undemonstrated technology. Historically and appropriately, the government is the organizational entity which undertakes high technology, high risk activities wherein it is perceived that these activities have social value for the country. An example is nuclear fission and fusion.

The market for stereoscopic imagery was far from certain. To have created a joint private sector/government institutional structure to implement Stereosat, the government must have viewed the uncertainty of the marketability of the product vis-a-vis the ability to have generated sufficient revenues to pay the cost of the system as having been a major determinant in the willingness of the private sector to participate. That is, the private sector investment decision encompasses both the market's ability to provide revenue, a question of sufficiency, and the probability that the potential can be achieved, a question of certainty. The government has traditionally been more effective in formulating policies that reduce uncertainty than in attempting to develop a market.

Having now organized the various institutional structures which might have been used to implement Stereosat on a continuum from all government to all private, it is conceptually appropriate to map a perception of the market for the stereo images onto that continuum. That is, if the market was viewed as being very small and there had been valid policy reasons for implementing Stereosat, the government could have undertaken the mission as an appropriate governmental function and not attempted to recover any cost of the system from

the private sector, that is, the end user. At the other extreme, if the market had been relatively certain and the only question was the actual return on the investment to be achieved, then it was clear that the private sector would undoubtedly have undertaken such an activity. This is the classic case of needing to see a market before making an investment to develop that market and achieve a return on investment. That is to say, private sector entities are willing to undertake limited business risk and technological risk. Technological risk is often reduced through insurance. Combining the continuum of organizational structures with this perception of the market yields a continuum of institutional structure options which are influenced by the ability of the market to provide a return on investment, that is, to pay part of the cost of the system. As the perception of the market's ability to repay the cost of the system increased, the type of institutional structure which could have been undertaken for the Stereosat mission may have changed over that perceived market. This concept is best explained by a few examples.

If the market was viewed as very speculative but contained within it sufficient monies to allow for some private sector investment, then it may have been appropriate for the government to appropriate the total cost of the system to a trust fund. The private sector would then have been encouraged to draw upon this trust fund to implement and build the system. The private sector would, as it sold data, have paid monies into the trust fund. Should the market in have fact been larger than expected, once the trust fund was amortized, the activity would have been entirely in the private sector.

As the perception of the market increased it may have been appropriate to create a private corporation by Congressional enactment, ala COMSAT, to undertake the Stereosat mission. For this to happen there would, of course, have to have been a perception that the market was, if not totally able to pay

the cost of the system, at least able to pay a significant part of the system cost with the government providing the remainder of the revenue.

E. THE INFLUENCE OF STEREOSAT AS A PUBLIC GOOD ON INSTITUTIONAL STRUCTURE

A public good "differs from a private consumption good in that each man's consumption of it ... is related to the total ... by a condition of equality rather than of summation."[55] Information is a classic example of a public good. The same information can be simultaneously owned by more than one person without denying either the benefits of ownership.[56] This held true for Stereosat data.

Public goods typically have the properties of jointness of supply and nonexcludability. Jointness of supply means that "once a unit of the service is made available to one individual, a service unit of the same quality can be made available to other individuals at no extra cost."[57] Nonexcludability means that "once a unit of service is made available to one individual, a service unit of similar quality not only can but must be made available to all other individuals."[58] Stereosat had the first of these properties to a reasonable approximation. Once Stereosat was launched and data collection had begun, the marginal cost of collecting additional data or making available additional copies of the images was very small relative to the cost of the system. The Stereosat operator would not have been able to preclude

---

55 P. Samuelson, Diagrammatic Exposition of a Theory of Public Expenditure, 37 Review of Economic Studies, at 350 (1955).

56 M. Porat, Communication in an Information Society, in G. Robinson, Communications for Tomorrow, Policy Perspectives for the 1980's, 35 (1978).

57 J. Head, Public Goods and Public Welfare, at 77-8 (1974).

58 Ibid., at 80.

reproduction of images without government intervention in the form of creating a new property right in the information.[59] This is discussed below.

Stereosat images were concluded to have sufficient properties of classic public goods to treat them so. If the government had proceeded to implement Stereosat as a traditional government activity, it could have distributed Stereosat images in the same way as Landsat images. The government had an interest in wide dissemination of the data and could have sold the images for the cost of reproduction only.

Any private sector/government institutional structure would have had to have a mechanism to prevent the appropriability of its product, the Stereosat images. It was not clear how this protection could have been provided since information lends itself poorly to classical legal concepts of property rights.[60] This difficulty would have been faced by any private sector or private sector/government entity implementing Stereosat. Although the measures taken to protect the images may have varied depending on the precise institutional structure created, the existence of these public good properties would not have significantly influenced the choice of institutional form.

Further along, as the market was more certain it may have been desirable to select a monopolist and guarantee him a market, but provide for private sector investment to implement the system. Even further along, if the market had been considerably stronger, it may have been desirable to have the government merely regulate the activity and throw it open to anyone who wanted to enter the market as competitors subject to regulation. At some point, when the market was perceived as being sufficient to recover the entire cost of the

---

59 See, C. Reich, the New Property, 73 Yale L.J. 733 (1964).

60 M. Porat, at 35.

system, there would have been no reason for the government to be involved other than to meet the legal and institutional requirements discussed below.

Thus, perhaps the most significant criteria on the selection of the appropriate instrument was the perception of the ability of the market for stereo images to generate sufficient revenues to repay the cost of the Stereosat system.

F. CONSTRAINTS

There are a number of legal and institutional issues which would have impacted the type of organization created to implement Stereosat. For analyzing how the government would make a decision on an appropriate institutional structure to implement Stereosat, it was sufficient to recognize that these constraints were not insurmountable, that is, they did not eliminate any organizational options from consideration. In any selected option there were certain activities which must have been undertaken by the government to insure the success of creating the type of organization that was being considered. These issues are more fully discussed below where the impact of each issue on specific institutional structures is analyzed.

G. CONCLUSIONS

The analysis of the types of joint private sector/government institutional structures which might have been created to implement Stereosat identified a number of issues which must be resolved to proceed. The Stereosat mission was first analyzed to identify those subsystems which had characteristics of a natural monopoly. It was argued that public policy should be to restrict monopoly power to those activities which are natural monopolies. The government might have been able to attract private sector

participation in all components of Stereosat. Thus, the government could have had two sets of private sector participants in Stereosat, those providing the raw data stream and those engaged in marketing products derived from the raw data stream.

The analysis then moved to the types of institutional structures which might have been created to implement Stereosat. These institutional structures were viewed as existing on a continuum from all government activity to an all private sector one, with joint private sector/government hybrid organizations in between. The appropriateness of a specific institutional structure was a function of the market's ability to provide a return on the private sector investment. Regardless of the specific institutional structure proposed, the government would have had to ameliorate some economic, legal and institutional constraints.

The government wished to encourage private sector participation in Stereosat. The private sector would have participated if it had seen an investment opportunity with a potential return greater than alternative investments. The government wanted to commercialize space activities, especially earth observation activities, as soon as it could reasonably do so.

It is commonly acknowledged that the government has had a very poor record in demonstrating ability to market products to the private sector. The private sector has considerable expertise in developing markets. It has been argued above that the perception of the market was a major consideration in selecting an institutional structure. Therefore, the government might have wished to rely on the private sector's demonstrated expertise in assessing market and allow it to come forward with specific proposals for implementing Stereosat with private sector participation. That is to say, there does not appear to have been any need for the government to a priori have selected an

institutional structure to implement Stereosat. The government could announce the proposed program and set any appropriate ground rules; for example, participants providing the raw data stream might not compete in the processing of the data. The government would then have had to be prepared to evaluate the proposals advanced. Should no acceptable proposals have been forthcoming, the government would have had to be prepared to implement Stereosat as an all government mission.

This "wait and see" approach imposed two requirements on government. It should have had a consistent analytical framework to compare the proposals advanced, and it should have understood to some degree the extent of the market for stereo images. The latter requirement was necessary to formulate an appropriate government participation, both in form and amount. It was expected that the private sector proposals would have proposed an institutional structure and a subsidy form and amount. The government should have been able to independently evaluate the subsidy request.

H. TWO CASE STUDIES

In the course of the studies undertaken, two concepts to implement Stereosat were advanced, one by NASA and one by a private corporation. Each concept is discussed below. NASA had considered a joint private sector/ government institutional structure which gave the private sector the market development responsibility and opportunity. The private corporation suggested it would undertake implementation of the entire Stereosat system with government underwriting of a portion of the required revenues.

1. Private Sector Marketing Proposition

Under this model the government would have procured the spacecraft, launched it, and begun to transmit data to the earth. The government would

have provided a stream of raw data from Stereosat to the private sector. One or more private sector entities would have built the facilities to process the raw data stream provided by the government and converted it into marketable Stereoscopic products which would then have been sold to end users. Thus, the interface between the government and the private sector would be at the raw data stream. See Figure 3. The private sector entity or entities which undertook this data service activity would have garnered return on investment by the difference between the product price to the end user or to other value added processors, and the price it paid the government for the raw data. Even within this relatively simple concept of a joint private sector/government arrangement, there were a number of options which could have been considered in its implementation.

The respective duties of the government and the private sector entity would have been for the government to guarantee data at the interface, that is, the raw data stream. The private sector would have agreed to market and develop the products, and would have guaranteed throughput, that is, that they would have rapidly converted the raw data into useable products which would then have been distributed into the private sector.

There were a number of ways in which the government could have proceeded to implement this concept. The first, and perhaps the most desirable in terms of having the fewest numbers of operative constraints, would have been for the government to have announced the data availability at a fixed price in terms of the raw data. With this announcement of a fixed price then any private sector entity who wished to operate a data service would have contracted with the government to procure the raw data, built its own data handling system, and perhaps developed selective markets. See Figure 4. This option basically made the government a raw material producer.

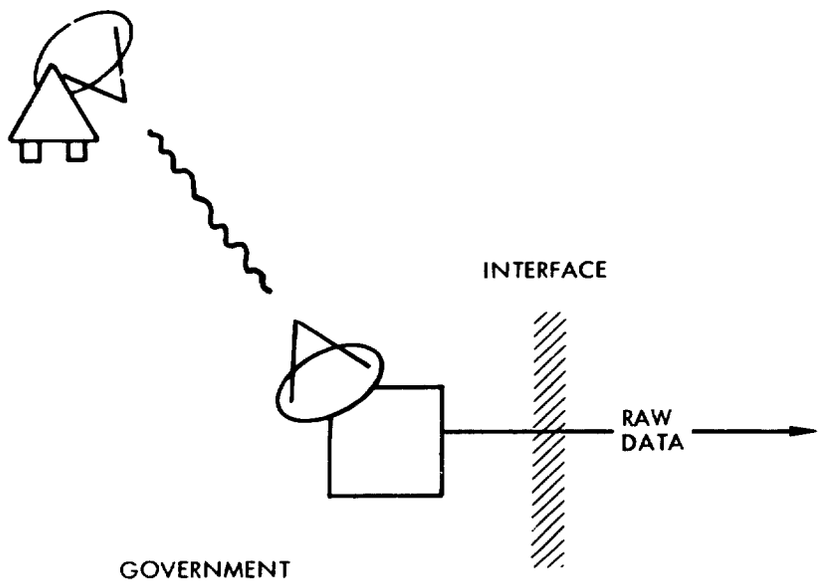
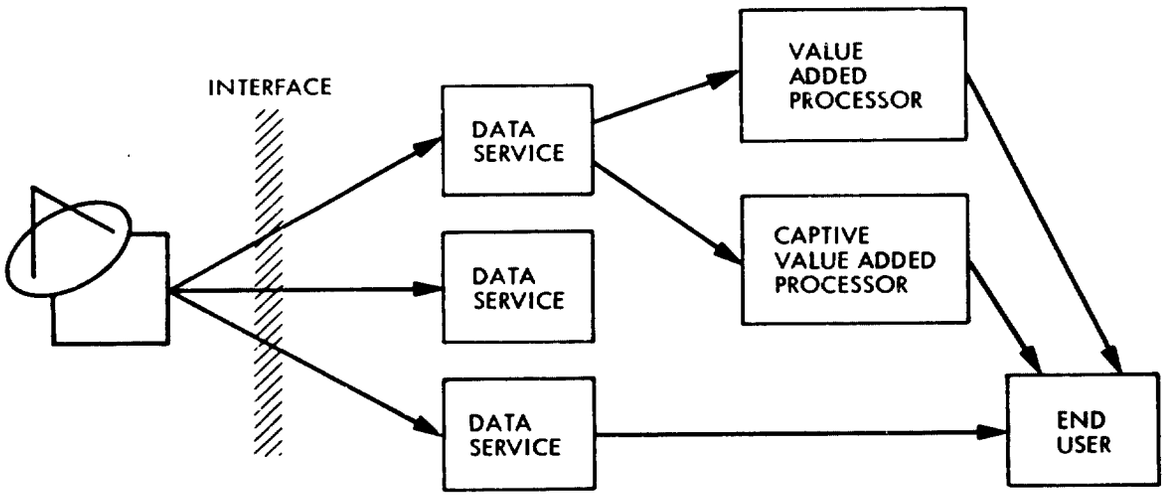


Figure 3. Private Sector Market Development



GOVERNMENT

- GUARANTEES DATA AT INTERFACE
- ANNOUNCES DATA AVAILABILITY
- (?) ANNOUNCES FIXED PRICE FOR RAW DATA

PRIVATE SECTOR

- BUILDS OWN DATA HANDLING SYSTEM
- DEVELOPS SELECTIVE MARKETS
- GUARANTEES THROUGH-PUT

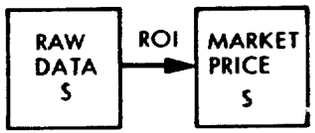
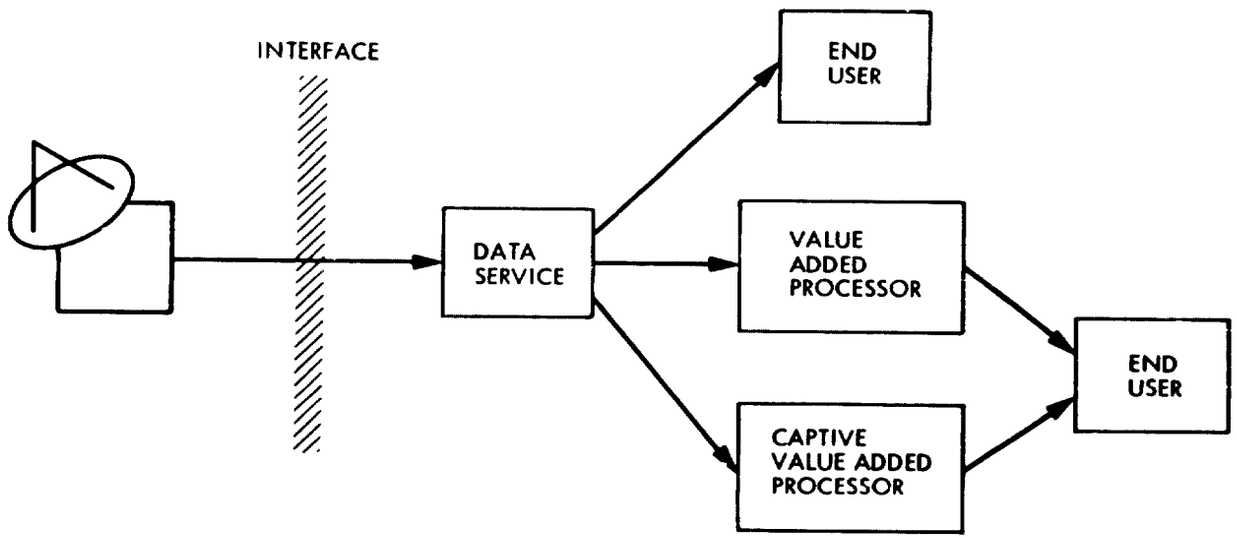


Figure 4. Competitive Data Services

Another option to have insured that at least one private sector entity stepped forward to operate this data service would have been for the government to have issued a request for proposal (RFP) to select a data service entity. One of the selection criteria for the data service would have been the amount of investment that the entity was willing to commit to the venture. This data service would have had to balance the price to be charged versus its investment and the price it was willing to pay for the raw data to guarantee its required return on investment. In other words, the respondents to the RFP would in their proposal would have had to suggest a raw data price to the government and specified a market price structure for the end product. It should be acknowledged that most of these people would have wanted the data to be provided free. This issue could have been handled by setting a minimum price. In this model the government would have guaranteed a temporal exclusive franchise by the selection of at least one data service to initially receive government support. That support could have been the exclusive right to sell to the government for some negotiable fixed period. The exclusive franchisee who received government support would have been able to sell to any private sector entity, that is, develop the private sector market. See Figure 5. At some later time as other private sector entities became more informed about the extent of the market, they would have been encouraged to enter it by building their own data processing facilities. The original franchisee would undoubtedly have continued to compete as other data processors entered the market. At some point this original franchisee would no longer have received government support.

Should no one have stepped forward even to respond to the RFP, the government could have insured that this data be made available to society at large by appropriating money to a trust fund which would have been used to



GOVERNMENT

- GUARANTEES DATA AT INTERFACE
- ISSUES RFP TO SELECT ONE DATA SERVICE
- COMPETITIVE SELECTION

PRIVATE SECTOR

- BUILDS OWN DATA HANDLING SYSTEM
- DEVELOPS MARKET
- GUARANTEES THROUGH-PUT

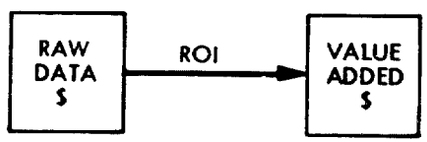


Figure 5. Data Service Selected by RFP

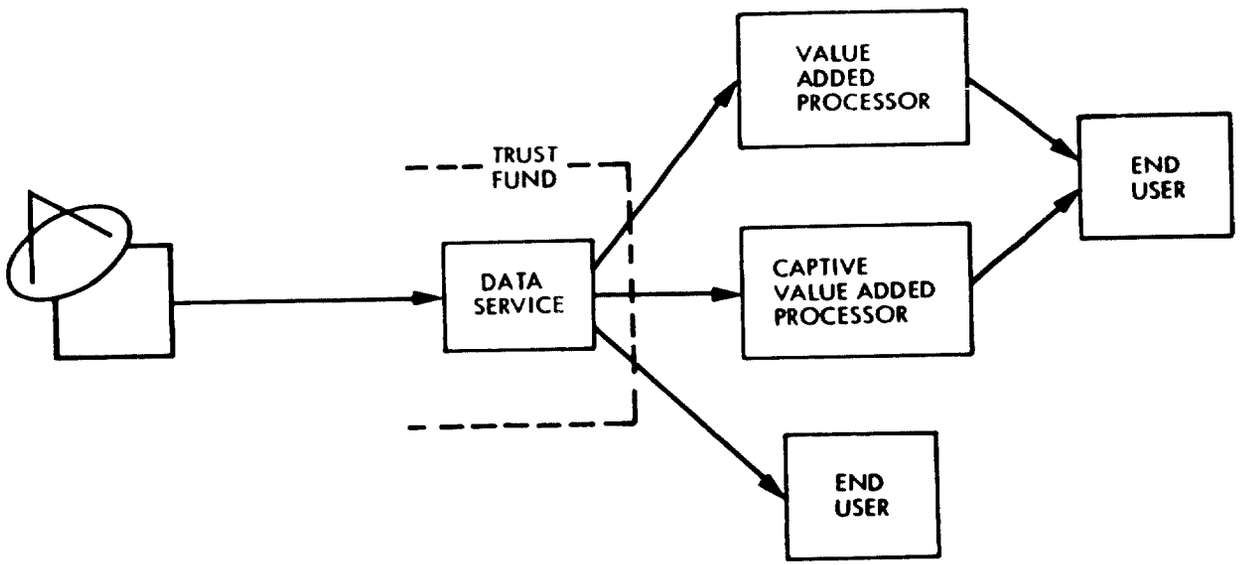
build the data processing facility. The government could have used its standard procurement process to select a contractor to build and operate the system using the trust fund monies. In the method of selection of the operator, one of the criteria would have been the contractor's commitment to buy out the trust fund at some time in the future, that is, pay back the initial trust fund monies. This meant that when the trust fund had been repaid, this option became the one discussed previously.

In the trust fund model the government would not only have set the raw data price but would also have set the market price and the contractor operator would have received a fixed profit just as contractors receive today for operating governmental facilities. If the market developed and appeared to be greater than initially expected, there could have been incentives that induced the private sector operator to buy out the trust fund and turn the operation into a private sector activity. Examples of incentives were discounts for early retirement of the trust fund and decreasing royalty fees. See Figure 6.

All of the issues discussed above would have to have been addressed in going forward with this type of activity. What this discussion points out is that even with a relatively small amount of private sector participation, a number of institutional options exist wherein the government could induce participation.

2. A Private Sector Proposition

A private corporation suggested that it use its own capital resources to build Stereosat, launch it, build the ground data handling system, and develop the marketing organization. The government would have had to guarantee to provide at least three-quarters of the revenues necessary to build and operate the system, that is, to recover the investment. The government would not have



GOVERNMENT

- GUARANTEES DATA AT INTERFACE
- CREATES DATA SERVICE WITH TRUST FUND
- COMPETITIVE RFP TO SELECT CONTRACTOR/OPERATOR
- BUILDS GROUND SYSTEM

PRIVATE SECTOR

- CONTRACTOR PAYS O&M
- BUY OUT REQUIREMENT CAPITAL RECOVERY FOR GROUND SYSTEM (I.E., TRUST FUND)
- GUARANTEES THROUGH-PUT

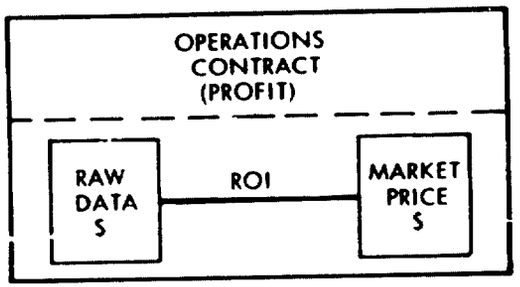


Figure 6. Trust Fund Data Service

paid the subsidy, a long term purchase agreement, until the raw data, to specification, was being transmitted by the satellite. If the satellite failed, either in not transmitting data or not meeting the specifications for the data, the government was not obligated to pay anything. In return for providing this guaranteed underwriting, the private corporation would have archived the data for the government. To effectively have created a market, the private corporation would have needed to be able to market to government agencies who are significant users of this data. By providing the underwriting, the government would have insured that Stereosat was implemented and the images would have been available.

If the market was in fact significant, then the amount of subsidy required to be provided by the government would have been reduced over time until there was no need for it. The government could have required the private corporation to repay the entire underwriting, or might have viewed the underwriting as a nonrecoverable sunk cost in procuring the Stereosat capability for the country.

This proposition was interesting in that it had much cleaner lines of responsibility than the trust fund option. Here the private sector entity assumed all of the risk of getting the spacecraft to the point of delivering data. If the spacecraft failed and no data was delivered, then the government would not pay. The private corporation thus assumed all the technical risk. What the private corporation did not assume was all the market risk. This proposition was, in fact, a direct underwriting with the private corporation being selected as the "chosen instrument" to implement Stereosat. The government would have created a monopoly in a legal and temporal sense should it have undertaken this proposition.

It should be acknowledged that even though a particular private corporation made this proposition, other industrial organizations would undoubtedly have been interested in participating. The government would have to have developed some selection criteria and a method for choosing the entity or entities which would have been invited to participate.

SECTION IV

LEGAL AND INSTITUTIONAL ISSUES

A. INTRODUCTION

The purpose of the legal and institutional analysis was to identify those constraints which may have impacted on a decision to create a new institutional arrangement wherein the private sector and government would have participated in a joint venture to implement the Stereosat mission. Included in the types of constraints considered are existing law, procedure, and administrative regulation. Another set of issues deals with interagency concerns with respect to their particular charter and scope of concern. A third set of issues deals with the interface between government and private sector decision making. Although there may be issues other than the ones herein discussed, these issues are considered to be those potentially having had the greatest impact on the implementation of the Stereosat mission. It should be noted that some of these issues are entirely domestic in character while others are both domestic and international.

B. OUTER SPACE TREATY OF 1967[61]

The cardinal principle under which the Outer Space Treaty of 1967 was signed is the freedom of "exploration and use" of outer space "by all states without discrimination of any kind, on a basis of equality and in accordance with international law."[62] The one limitation on this provision is that the

---

61 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 4 N.T.S. 205 (1/27/67)

62 Article 1, paragraph 2.

exploration and use must be carried out for the "benefit and in the interest" of all countries irrespective of their degree of economic and scientific development.[63] This later provision has become known as the "common interest" clause, and has been regarded as requiring the states to share benefits not in any specific manner but rather as an expression of the general desire that the benefits be generically beneficial.[64] When this paragraph of the treaty was analyzed by the U.S. Senate Committee on Foreign Relations as it engaged in its constitutional function of giving its advice and consent to the President, the committee formally stated that "nothing in Article 1, Paragraph 1 of the Treaty diminishes or alters the right of the United States to determine how it shares the benefits and results of its space activities."[65] It is clear that the availability of a consistent set of stereoscopic images of the Earth's surface falls within the beneficial common interest provision of the Outer Space Treaty.

The Outer Space Treaty mandates that signatories to the Treaty shall be responsible for all activities in space whether carried on by governmental agencies or by nongovernmental entities. The activities of nongovernmental entities shall require "authorization and continuing supervision" by the signatory nation.[66] This provision has become known as the "control and supervise" provision in the treaty. The question raised is, "What constitutes appropriate authorization, control and supervision?" For example,

---

63 Article 1, paragraph 2.

64 S. Gorove, Freedom of Exploration and Use In the Outer Space Treaty, 1 Denver J. Int'l L. and Pol. 93 at 104 (1971).

65 Treaty on Outer Space, Report, 90th Congress, 1st Session, Executive Report Number 8, page 4 (April 18, 1967).

66 Article 6

if a private sector entity were to undertake Stereosat as a totally private venture, procuring the satellite, buying a launch from NASA, and operating the system itself and selling the data products, what responsibility and what management would the federal government be required to implement to meet the requirements of the treaty mandate? Does this require Congressional action? Is it appropriate to treat this private sector entity as a corporation subject to regulation by an agency such as the Federal Communications Commission? The impact of this "control and supervision" on possible models for joint private sector/government institutional structures is discussed later in the report. The issues of the extent and the boundaries of what constitutes "control and supervision" under the terms of the Treaty are discussed in Appendix 3.

The Outer Space Treaty also raises an issue with respect to access to earth observation data once collected and available for dissemination. U.S. policy has been and continues to be that all data will be available to anyone.[67] In the case of Landsat, imagery is available to any and all purchasers who pay the cost of reproduction of the data. For Stereosat the data would probably have to be available to any person who would be willing to pay the cost of the images or the CCTs. Fundamentally, there must be non-discriminatory access to the earth observation data.

A separate but related issue is exclusivity of the data. For a private sector entity to enter into the earth observation arena, that entity must have some way to protect its investment. For some joint private sector/government institutional models, the private sector organization must be able to collect the data from the satellite in an unique and exclusive way and be able to insure that it is the only collector of the raw data. In the case of Landsat,

---

67 PD-42.

there are today foreign ground stations which can receive data and reproduce it under license from the U.S. government. The technological solution for Stereosat raw data, in some of the applicable institutional models, is to encode it on the satellite and decode it at the ground station. Encoding the raw data does not appear to run afoul of the Treaty, as long as there is nondiscriminatory access to the final data product. U.S. policy on supporting direct foreign readout of data may preclude restricted access.[68]

A thornier issue is one which deals with controlling the exclusive nature of the data once it is disseminated to purchasers. This issue is not directly related to the Outer Space Treaty and is discussed below.

C. INTELLECTUAL PROPERTY PROTECTION

Earth observaton data has in the past only been collected by the federal government under the auspices of its research and development activities, primarily carried out by the National Aeronautics and Space Administration (NASA). There has been no need to provide intellectual property protection for this data since it is in the public domain and freely available to everyone. However, now that it appears that some earth observation systems may be commercially operational, before an investor would commit funds to participate in a earth observation space venture, he must be assured of protecting that which is of value and which provides his return on investment;

---

68 PD-54 says:

"c. International Participation. The United States will generally support non-discriminatory direct readout to foreign ground stations to continue our present policy and to provide data to foreign users under specified conditions. Pricing policies must be developed that are consistent for foreign and domestic users. We will promote development of complementary nationally operated satellite systems so as to limit U.S. program costs, but protect against unwarranted technology transfer." (U)

the earth observation data itself. It should be noted that the issue here is not access to the data. Any private sector participant in an earth observation activity would be required to provide free access to the data; that is, any person wishing to purchase the data would have a right to obtain that data by paying the purchase price. The issue here is one of controlling the dissemination of the data in such a way that the investor can capture a return on his investment. Controlling access to the raw data as it comes from the spacecraft down to earth has a technological solution; either the data can be encoded or the spacecraft can only dump data at particular times to a unique ground station. The more critical problem is controlling the data once it is sold to a customer. In economic jargon, this is known as the appropriability problem.

A theoretic policy recommendation made above was to restrict a private sector entity to that portion of the system that is a natural monopoly. Assuming for all the reasons earlier discussed that the natural monopoly encompasses the downlink, the product of the natural monopoly is the raw data stream. If the monopolist wants to make a return on his investment, he must have a way to enforce his property rights in the product, the raw data stream. Once the raw data stream is sold to a data processor, the monopolist has no effective control over that data or the uses to which it is put. The monopolist can prohibit each data service from reselling the raw data through contract provisions. This protective measure may not be effective since the cost of policing it is high. The monopolist's only sanction is a refusal to sell raw data to the offending data processor. If that data processor wants to stay in business, he has an incentive to acquire the raw data in a black market by broadcasting his willingness to buy. While other data processors, as organizations, can refuse to participate in the black market as sellers for

fear of having their own data stream cut off, there is virtually no way, at reasonable cost, to police the employee who may expropriate the data without his employer's knowledge. Thus, given these assumptions, the existence of a black market is a virtual certainty.

The appropriability problem is not solved by the government participating in the natural monopoly; it is, however, shifted to the data processors where its effects may more reasonably be reduced. If the government participates in the spacecraft and the downlink, the natural monopoly, the private sector participant is guaranteed a return on its investment by the government. For granting this return on investment, the government assures that the raw data become available. The private sector participant in the natural monopoly now has no need to exercise property rights over the raw data.

The data processors will sell the primary data product to end users or to value added processors, or will sell value added products directly to end users. Where the data processor is selling the primary data product, stereo images or CCT's, the data processor faces the same appropriability problem -- keeping subsequent purchasers from undercutting. Since the most likely form of value added processing is merging Stereosat imagery with other existing data sets, the unique methodology employed in creating the unified end product will give it a distinctiveness over which the data processor will have control. An example is commercial mapmakers. Their common practice is to make a slight error in each map, one that does not affect the usefulness of the product. By watching other mapmakers' products and identifying the deliberate error, their property rights may be enforced. There may be similar ways to tag Stereosat data.

Where the primary data product is sold, the data processor really only has resort to a refusal to sell to enforce its property rights. This

sanction is ineffective where there are multiple data processors. One way to create a distinctive product, that is, to protect a property right, is for the data processor to sell only products that have some value added processing done to it. This may be some slight enhancement or method of presenting the data. There may be technological ways to tag the data.

Other than using contract provisions or technological tags, enforcement of property rights in the data is difficult. Since the government wanted to attract private sector investment in Stereosat, it could enhance the attractiveness of the investment by facilitating protection of property rights in the data. The primary mechanism for enhancing these rights is to provide legal protection for the Stereosat data. Some protection is already afforded by the Copyright Act, but the most desirable protection would be specifically enacted statutory protection.

Copyright

Photographs are protectable by copyright under the 1976 Copyright Act.[69]

> "Copyright protection subsists, ..., in original works of authorship fixed in any tangible medium of expression, now known or later developed from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or a device. Works of authorship include ... (5) pictorial, ... works.[70] A work is "fixed" in a tangible medium of expression when its embodiment in a copy ..., by or under the authority of the author, is sufficiently permanent or stable to permit it to be perceived, reproduced, or otherwise communicated for a period of more than transitory duration.[71]

These statutory provisions make it clear that photographic images and analyses done using digital data which ultimately take the form of

---

69 17 U.S.C., entitled, "Copyrights", Pub. L. No. 94-553, 90 Stat. 2541 (1976).

70 17 U.S.C. 102(a).

71 17 U.S.S. 101.

photographic images would be protectable under the Copyright Act. The problem, however, is that once the image is sold by the processor into the private sector, the processor has no way of guaranteeing that the image is not reproduced and resold. Without some protection against resale it is doubtful that a private sector processor would invest funds in an earth observation system because he has no way of protecting the product he has created.

The undesirability of copyright protection for the stereo imagery is evidenced by the remedies provided by the act. Three types of remedies are provided: injunctions[72], impounding and disposition of infringing articles[73], and damages and profits[74]. The first prerequisite for any of these remedies is, of course, that the copyright holder be aware of an infringement. With data sold into the private sector which is to then be merged into other data bases, there is virtually no way for the data producer to ascertain whether or not there is an infringement of the exclusive copyright.

Under the injunctive remedy, a court may order temporary or final injunctions on such terms as it may deem reasonable to prevent or restrain infringement of a copyright.[75] During the course of any infringement proceding under the Act, the court may order the impounding of any copies or other articles which are being used to infringe on a copyright on such terms as may be deemed reasonable by the court until such time as a final resolution

---

72 17 U.S.C. 502.

73 17 U.S.C. 503.

74 17 U.S.C. 504.

75 17 U.S.C. 502(a).

is decreed.[76] As part of the final judgment or decree the court may order destruction or reasonable disposition of the articles that have been impounded plus any others that might be subject to the final order.[77]

The statute provides two types of damages and profits. The first is actual damages and profits wherein the holder of the copyright bears the burden of showing not only that an infringement occurred but that he suffered actual damages. The holder has the right to recover the infringers profits based on a showing of the infringers' gross revenue. The infringer is then required to prove his deductible expenses and elements of profit attributable to factors other than the copyrighted work.[78] This means that statutorily the holder of the copyright has an easier burden to show profits illicitly gained from infringement of the copyright. The holder must merely prove the gross revenues of the infringer and then the infringer must show what portion of that is attributable to deductible expenses. This is contrasted with the traditional burden wherein the holder would have to show the net profit impact, that is, to show both gross revenue and deductions.

The act also provides for statutory damages upon the election of the copyright owner. An individual or multiple infringers are jointly and severally liable in a sum not less than $250 or more than $10,000 as the court considers just.[79] In the case where the holder of the copyright is able to show that the infringement was committed willfully, the court, in its discretion, may increase the award of statutory damages to a sum not more than

---

76 17 U.S.C. 503(a).

77 17 U.S.C. 503(b).

78 17 U.S.C. 504(b).

79 17 U.S.C. 504(c)(1).

$50,000. Where an infringer shows that he was not aware and had no reason to believe that his acts constituted an infringement of copyright, the court, in its discretion may reduce statutory damages to a sum not less than $100.[80]

The fundamental problem for the data processor in the earth observation arena will be to meet the burden of showing damage. Even under the statutory damage scheme, the holder is relying on the court's discretion in the award of damages. It will be difficult for the holder to demonstrate actual damage in the situation where one purchaser gives a stereo pair of images to another person. The question is, "What are the actual damages sustained by that activity?" In actual monetary amounts, the transfer of a pair of images or one CCT is probably small. The problem for the private sector investor is not that he has not sustained damage, but that he must prevent a black market or free exchange to occur in order to protect his investment. The Copyright Act as now constituted does not appear to provide sufficient protection. Therefore, before a private sector investor would come forward he probably would request statutory protection for this earth observation data which is separate and unique from that provided by the Copyright Act.

There are cases under the copyright and patent laws wherein computer algorithms are now protectable. This is especially important in the earth observation arena since the technology will probably advance significantly as more data is handled in a computer mergeable form. Here too, the private sector investor must be able to prohibit effectively free use of his product in a secondary market.

A further problem arises in the international dissemination of this data. The statutory protection of the copyright exists only within the United

---

80 17 U.S.C. 504(c)(2).

States and its territories. There is an international copyright act to which the United States is a signatory. It may be possible to enforce copyright protection against other signatories to the international copyright act, but there is no guarantee that infringers will be curtailed. Also, it is unclear what types of damages and remedies are available under that international act.

D. FREEDOM OF INFORMATION ACT

The Freedom of Information Act, Public Law 93-502, 88 Statutes 1561 (1974), (codified at 5 U.S.C. Section 552), was intended to provide greater public access to the operation of the federal government. The importance of the Freedom of Information Act to earth observation data is a function of the following provisions: "...each agency, upon any request for records..., shall make the records promptly available to any person."[81] The agency disclosing these records may charge a fee; however, "Such fees shall be limited to reasonable standard charges for document search and duplication and provide for recovery of only the direct costs of such search and duplication."[82] This provision is operative on the EROS Data Center which provides Landsat imagery for the cost of reproduction.

Any institutional arrangement undertaken by the federal government where, directly or indirectly, the federal government is in possession of Stereosat data would make the provisions of the Freedom of Information Act applicable. Thus, the federal government would be in the position of attempting to induce private sector investment where the maximum price that could be charged to the ultimate user of the information was the cost of reproduction. No private

---

81 5 U.S.C. 552(a)(3).

82 5 U.S.C. 552(a)(4)(A).

sector entity would enter into this type of arrangement. Thus, it appears clear that any arrangement which involves both the private sector and government would require an amendment to the Freedom of Information Act. It should be noted that in the bills in the House and Senate which have been offered dealing with earth observation data, an exclusion is provided from the provisions of the Freedom and Information Act. These bills are discussed in Appendix 2.

E. OWNERSHIP ISSUES

Traditionally, when the government enters into an activity where government monies are used to provide the capital investment in the system, the ownership of that system remains in the public domain. It may be operated by a contractor and may, in fact, have its primary benefit accruing to the private sector. For example, the Tennessee Valley Authority (TVA) is a public sector activity operated for the primary benefit of the private sector. Where the government provides all the funding it is clear that facility would be owned by the U.S. government.

When entering into an institutional arrangement wherein the private sector would contribute capital dollars, the questions of ownership of the respective portions of the system undoubtedly arise. It is reasonable to assert that if the overall system which is untimately created has unique and identifiable separable segments, then those segments built by the private sector would undoubtedly remain in the private sector, and those facilities provided with government funds would remain in the public domain. This would not dissuade the private sector entity from participating because their return on investment would be assured from the operation of the overall system and would be based on a smaller capital investment than if the private sector had

provided the money for the entire system. The private sector entity is still subject to governmental control and supervision, and regulation.

In the case where there is no easy way to separate that portion of the system which is paid for by private sector monies and that portion paid for by public funds, ownership questions become unclear. At the present time there is no clear resolution of these issues; however, there have been cases of joint ownership in the past. One way of handling this problem is via a royalty arrangement which would allow the private sector entity to garner a return on his investment.

F. REGULATION

In the earlier discussion of the Outer Space Treaty, mention was made of the need to "control and supervise" private sector entities who might be involved in earth observation. Once the necessity for some form of regulation is acknowledged, the question becomes: "Who does the regulation and under what types of rules?" It is clear that the National Aeronautics and Space Administration (NASA) is a science, research and development organization and has no regulatory charter, experience, or mandate. In one of the bills to be discussed above, regulatory responsibility is given to the Federal Communications Commission (FCC) based on their responsibility for communications satellite activities.[83] PD-54 appears to give regulatory authority to the National Oceanic and Atmospheric Administration (NOAA).

---

83 The FCC has expressed a strong preference not to be given regulatory oversight of space remote sensing systems. Operational Remote Sensing legislation: Hearings on S.663 and S.875 before the Subcommittee on Science, Technology, and Space of the Senate Committee on Commerce, Science, and Transportation, 96th Congress, First Session, Part II, at 254 (July 31, 1979) (statement of Stephen J. Lukasik, Chief Scientist, Federal Communications Commission).

There are many subissues contained within the question of regulation which have not been examined in any great detail. The type, scope, and character of the needed regulation, should it be required, would have to be examined once the type of institutional structure for joint private sector/government participation in Stereosat was decided upon, or at least the range of options narrowed to a manageable number.

G. ANTITRUST

Antitrust issues should not be a significant factor in creating a joint private sector/government institutional structure for Stereosat. There are however, situations wherein questions of antitrust and monopoly power would have to be addressed. Should the U.S. government undertake to create a monopolist who would control the processing of earth observation data, then clearly this entity would have to be regulated by some segment of the government. There is a general tendency, well-founded and desirable, to not want to create monopolies but rather to foster competition. Thus an activity which would result in a monopoly, either legal or temporal (in the sense of being the first to enter an activity), could be avoided by judicious planning at the outset.

Another situation wherein antitrust issues may arise is if earth observation activities, in particular Stereosat, were to be undertaken entirely by a private sector entity. Although an individual corporation could come forward and propose to undertake this activity subject to all of the strictures discussed above, such as freedom of access, there is no guarantee that the entity which is either chosen or comes forward would necessarily be one which would have the desirable characteristics. It may be possible that the type of organization which might be created to act as the processor of the

earth observation data is a industrial organization, typically a corporation, created by ultimate end users who would provide private capital in return for shares in this subsidiary corporation. For example, the major oil companies could combine together to create a corporation to do this data processing. If such an organization were created, it is clear that questions of sharing of data and price fixing amongst the ultimate end users, acknowledging that they are merely investors in subsidiary corporation, would arise with respect to whether this is a desirable type of institutional structure to have in the earth observation arena. These issues are ill-defined at present and require further analysis.

H. SUMMARY

The discussion above has identified a number of potential legal and institutional issues that would have had to have been addressed to create a joint private sector/governmental institutional structure for Stereosat. There are undoubtedly other legal issues as yet unidentified, and some here discussed may in fact not be significant issues. The intent of this section has been to identify those that appear to be significant in the current time frame.

I. CONSTRAINTS

This section of the report examines the potential impact of some of the legal and institutional constraints on the types of institutional structures which might have been created to implement Stereosat. See Figure 7. Figure 7 displays the legal and institutional issues down the left column and the continuum of organizational structures across the top of a matrix. The impact of each issue is then displayed in the appropriate box in the matrix.

ISSUES	TYPE OF ORGANIZATION		
	GOVERNMENT	JOINT PRIVATE SECTOR/GOVERNMENT PUBLIC TRUST ••• CHOSEN INSTRUMENT ••• REGULATED MONOPOLY	TOTAL PRIVATE SECTOR
FREEDOM OF INFORMATION ACT (FOIA)	1. DATA AVAILABLE FOR COST OF REPRODUCTION ONLY-NO CHANGE 2. RECOVERY OF INVESTMENT-FOIA MUST BE AMENDED		NOT APPLICABLE
OUTER SPACE TREATY (OST) "CONTROL AND SUPERVISE?" A. ACCESS TO DATA B. EXCLUSIVITY OF DATA	GOVERNMENTAL ACTION	GOVERNMENT MUST TAKE SOME AFFIRMATIVE ACTION TO "CONTROL AND SUPERVISE" ● RESPONSIBLE AGENCY? ● EXTENT OF SUPERVISION?	
ANTI-TRUST	NOT APPLICABLE	PUBLIC UTILITY COMMON CARRIER	DATA SHARING
INTELLECTUAL PROPERTY PROTECTION	NOT APPLICABLE FOR COST OF REPRODUCTION OPTION	GOVERNMENT COULD PROVIDE STATUTORY PROTECTION COPYRIGHT ACT INADEQUATE TO PROTECT RECOVERY OF INVESTMENT	
OWNERSHIP OF "SYSTEM", "DATA"	GOVERNMENT	SHARED PARTICIPATORY RIGHTS	PRIVATE SECTOR

Figure 7. Constraints on Potential Institutional Structures

The Freedom of Information Act is not applicable if Stereosat was an all private sector activity. However, if there would have been be any recovery of investment, even if the mission were undertaken solely by the government, then the Freedom of Information Act should be amended. If the data was available for cost of reproduction only, the Freedom of Information Act does not have to be amended and is applicable.

Under the Outer Space Treaty provision to "control and supervise," if the government undertook Stereosat as a traditional space mission, there was no issue because the government was undertaking the action. If, however, a hybrid organization or total private sector entity undertook Stereosat, then the government must have taken some affirmative action to "control and supervise." This raises the issues of the responsible agency and the extent of supervision.

If Stereosat was an all government activity or heavily government in the form of a public trust wherein the monies came from the Treasury, then no antitrust issues were relevant. However, regulated monopolies and regulated competitive industries might have encountered antitrust issues with respect to the designation of these entities as public utilities or common carriers. If the activity was total private sector, there may have been some questions with respect to data sharing.

There was no need for intellectual property protection if Stereosat was undertaken as a governmental activity and the data were sold for the cost of reproduction only. In a hybrid organizational structure where there is an attempt to recover the cost of the system, copyright protection only was inadequate to protect the recovery of investment, and the government should have provided some statutory protection to induce the private sector to invest money.

Ownership of th. system in the hybrid types of organizations required some form of shared proprietary rights, whereas within the private sector the system would belong to the private sector entity.

The issues identified in Figure 7 were not insurmountable in that they did not eliminate any organizational options from the number which might be available. What Figure 7 demonstrates is that for any selected institutional structure, the government would have had to make appropriate changes in the existing body of law and procedure.

Considerable work remains to be done to understand the full ramifications of the types of legislative packages, contractual arrangements, interdepartmental negotiation and other similar issues which would be required to implement a particular selected organizational structure.

SECTION V

SUMMARY AND CONCLUSIONS

The Stereosat Policy Study Task was the result of the confluence of two movements. First, the geosciences industry had identified a worldwide consistent set of stereo images obtained from a satellite as a pressing national and international need.[84] Representatives of the industry advocated the mission which ultimately became Stereosat before Congress, to the President's Science Advisor, and to the National Aeronautics and Space Administration (NASA).

Second, Congress and the Office of Management and Budget (OMB), faced with funding requests for increasingly costly space missions, wanted the end users who benefit from these missions to contribute to their cost, preferably up front. Since Stereosat had a readily identifiable end user community, it became clear that for the mission to proceed some private sector participation would be essential.

As a result of this desire for a joint private sector/government venture, the Geosat Committee undertook a study of the potential market for stereo images. The Geosat Committee document has been widely distributed and has become the basis for arguments for a NASA commitment to launch a stereo satellite, and methods by which the costs of such a system might be supported by the data users. Based on the Geosat Committee market survey there appeared to be sufficient demand for satellite stereo data to offset at least some part of system costs through data sales.

---

[84] 47 U.S.C. 701.

While it is acknowledged by all persons in the geosciences community that the availability of stereoscopic imagery is a valuable asset to mineral exploration, at this time sufficient data to define the extent of the market for these products are not available. Potential markets outside the mineral exploration community are uncertain, and the future of the digital processing market is more speculative. The Geosat Committee market study is at best a benchmark for more detailed studies. It is insufficient for a decision to commit capital investment, either by the private sector or government, with the expectation of a reasonable return on investment.

It has been argued here that the uncertainty of the market for stereo imagery was one of the major determinants in the reluctance of the private sector to invest in Stereosat. As the private sector became more informed of the capabilities of Stereosat, it would have analyzed the market for the images before making any investment in the system. If the potential return on investment in Stereosat was perceived to be greater than alternative investments, the private sector would have made proposals to the government for implementing Stereosat. That is to say, the private sector would have participated with government to the extent they perceive an ability to make a return on their investment.

With the government focusing on evolving an operational remote sensing system which includes the private sector, Stereosat is not likely to proceed as an independent activity. Stereosat will have to be evaluated at some time in the future by both the government and the private sector in the context of the operational remote sensing system. When the decision is made to proceed, the issues discussed above will have to be addressed.

This preliminary and cursory examination of the issues associated with creating an institutional structure for joint private sector/government

participation in Stereosat may be generic in application. As the government proceeds with other earth observation activities, these issues with respect to private sector involvement will reoccur and must be examined in some detail. Thus, while it is hoped that this document would aid in the decision to proceed with a private sector/government institutional structure for Stereosat, it is hoped that the issues identified can be subjected to further analysis which would help resolve these issues for future earth observation activities.

APPENDIX 1

SOME REMARKS ON THE STEREO SATELLITE DATA PRODUCT MARKET ASSESSMENT OF THE GEOSAT COMMITTEE STEREOSAT TASK FORCE

by

Professor Leonard Jon Parsons

College of Industrial Management

Georgia Institute of Technology

November 30, 1979

The Geosat Report was a useful preliminary market assessment for Stereosat. However, the estimated global requirements for stereo data products may not even be a good ballpark figure. Some brief comments follow on selected aspects of the Geosat Report. These involve the disproportionate importance of a few prospects, the reliability of survey estimates of market demand, the relationship between Landsat and Stereosat users, the interdependencies among players, global stereo data products requirements, the pattern of sales over time and pricing.

Disproportionate Importance of a Few Prospects

The results reported (see Table 4.1) indicate that relatively few prospects will account for a large proportion of sales. In the exploration segment, one prospect accounts for 44 percent of that market, while in the service segment and the government segment it was 78 percent and 73 percent respectively. This theme is elaborated upon in Figure 1. The overall accuracy of any estimate of market demand is highly dependent on accuracy of the figures given by a very small number of prospects.

Reliability of Survey Estimates of Market Demand

There are three factors to keep in mind when considering the estimates of market demand. The first is whether or not the prospect knows its true demand. The second is whether what is the true demand at the time of the survey will be the true demand at the time the product is available. The third is whether the prospect will reveal what its true demand is.

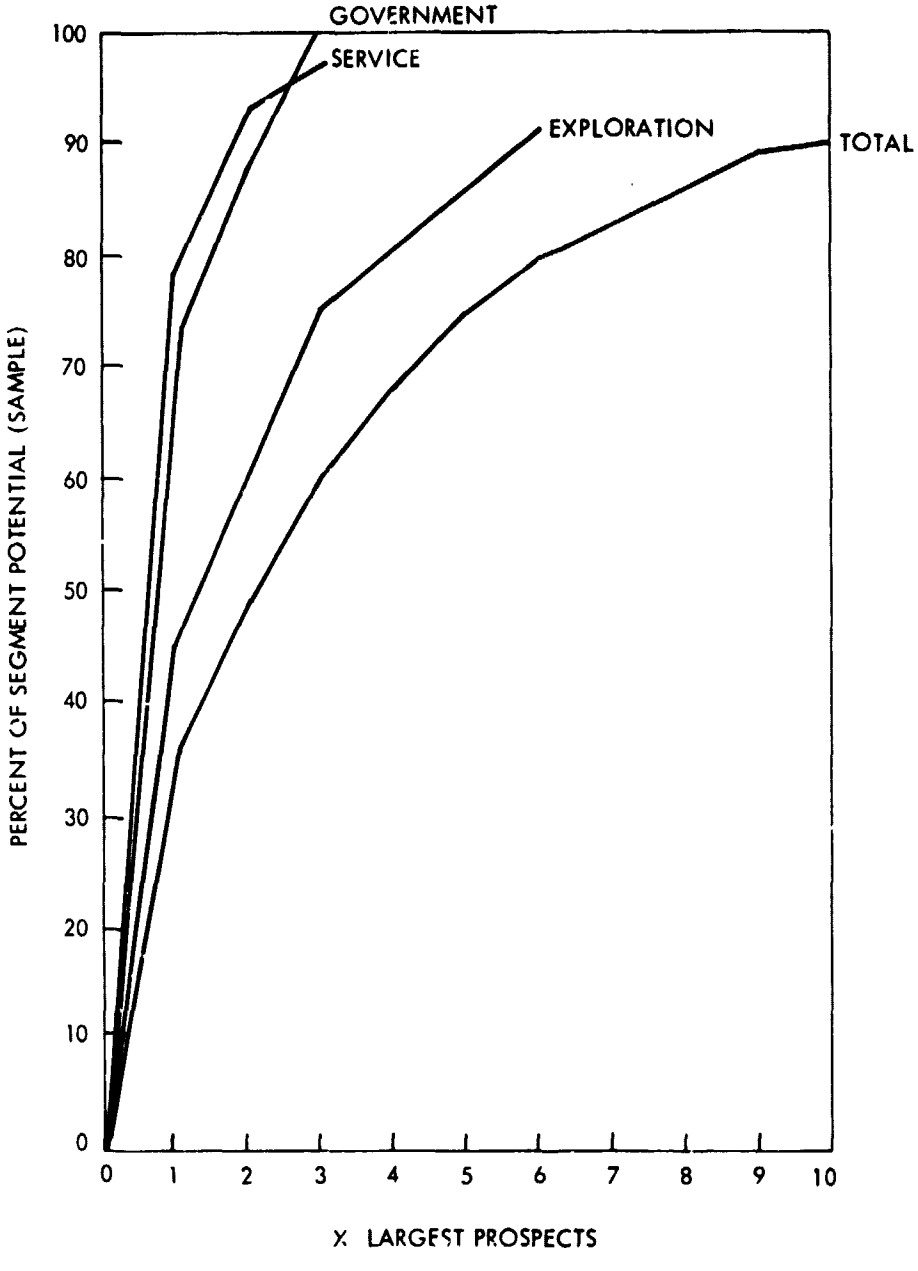


Figure 1. Percent of Potential by Largest Prospects

Let's consider these factors in reverse order. There is a real question about the truthfulness of the survey estimates of demand by individual prospects. If one wants the service to be available, one would overstate one's demand estimate. A counterbalancing influence would be a desire to maintain one's credibility with our federal government. This influence would seem to be most pronounced for domestic government agencies, somewhat less important for domestic private concerns, and perhaps negligible for foreign prospects.

The second factor can't be finessed. Intentions are not the same as behavior. Some might intend to buy and then won't, while the converse might hold for others. Scant attention seems to have been given to possible changes, if any, in the future environment.

The first factor is also very important. The prospects might not know what their true purchases will be. This is hinted at in Table 4.1. More than a half dozen survey participants stated that split between their domestic and foreign coverage needs was exactly fifty-fifty. Is this reasonable?

The Relationship Between Landsat and Stereosat Users

The relationship between Landsat and Stereosat users is not completely clear. Are there users of Landsat information that have no need for Stereosat information or those who might use Stereosat information who are not using Landsat information? If so, why and how many?

The Geosat Report in making its worldwide projections assumes a correspondence between Landsat and Stereosat customer profiles. Consider the following table:

	Landsat Users (Table 5.1)	Stereosat Users (Table 4.1)
Government	30-35%	9%
Industrial	23-29%	91%
Foreign	22-26%	0%
Others	14-21%	0%

While some industrial concerns in the Stereosat Survey might be classified as foreign, the difference in profiles is striking. The government component is relatively smaller for Stereosat. Why?

Interdependence Among Players

The Geosat Report does not adequately explore interrelationships among players. For instance, if exploration companies buy the Stereosat product, then those leasing mineral rights are essentially forced to buy to maintain parity. More importantly, some exploration companies belong to consortium and are known to share Landsat information (Table 4.3). This raises the issue that the Stereosat Survey might have overstated the market size because of "double" counting.

Global Stereo Data Products Requirements

The Geosat Report projects global requirements for stereo data products in the following manner (Table 5.2). The Stereosat Survey yields an estimate of demand by the Geosat industrial companies. The Geostat Report then conjectures that sales to these companies will comprise 80% of total domestic industrial sales. Total domestic industrial sales is consequently estimated by multiplying Geosat estimated sales by 1.2 (1.00/8 = 1.25). Then because domestic industrial sales are about 29% of total Landsat sales (Table 5.1), global requirements are estimated by multiplying the estimate of total domestic industrial sales by 3.4 (1.00/.29 = 3.4).

This questimate of the global requirements for stereo data products is very speculative. The survey estimate of the demand by Geosat industrial companies may be very inaccurate. The Geosat companies may account for a different proportion of the total U.S. industrial market than assumed. Finally, no justification is provided for assuming the profile of customers is

the same for Landsat and Stereosat. Given that these errors are multiplicative because of the chain ratio forecast of potential, little reliance should be placed on the estimate of global demand.

Sales Over Time

Cumulative sales of Stereosat data product is likely to be S-shaped. Initially sales might be low as users make small purchases of the product to evaluate it. Once this trial period is finished, sales should increase rapidly provided that the Stereosat product is satisfactory. Eventually sales will reach a saturation level as users find themselves purchasing at their capacities or capabilities. This pattern is shown in Figure 2. Annual sales would behave over time much like the Landsat sales. (Figure 5.1).

Pricing

No investigation of the sensitivity of demand to price was done. Nor was any analysis done on the pricing of CCT relative to Film. There are some indicators that some purchasers might be price insensitive. For instance, Italy charges much higher prices for Landsat products than does the U.S. On the other hand, one expert says that if prices were lower more prospects would buy a complete set of products. Since not just the quantity sold, but also revenue is important, pricing cannot be ignored.

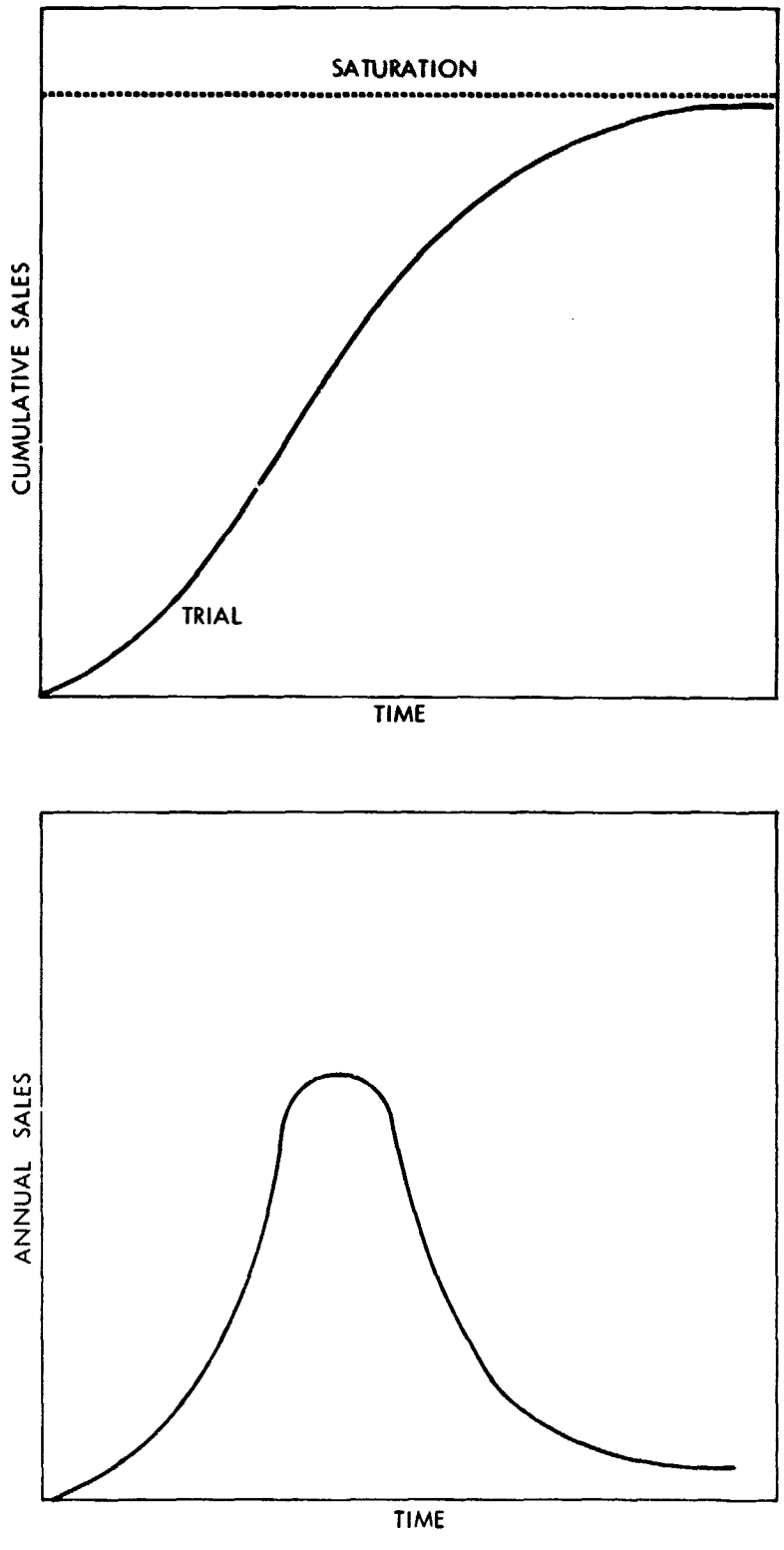


Figure 2. Time Pattern of Sales

C-2

APPENDIX 2

LEGISLATIVELY PROPOSED INSTITUTIONAL STRUCTURES FOR SPACE ACTIVITIES

APPENDIX 2

LEGISLATIVELY PROPOSED INSTITUTIONAL STRUCTURES FOR SPACE ACTIVITIES

Three bills have been introduced in Congress which would either explicitly create an operational earth observation system or facilitate its creation. The institutional structures created by these bills are examples of the generic types discussed in the report, and attempt to respond to some of the identified economic, legal, institutional and public policy issues.

S.663 (Stevenson)

The Earth Data and Information Service Act of 1979, S.663, 96th Cong., 1st Sess. (1979), introduced by Mr. Stevenson, would create an Earth Data and Information Service as an agency of the federal government within the existing structure of the National Aeronautics and Space Association (NASA). This bill is basically a "holding action" to provide for the acquisition and dissemination of Earth resources data by the federal government until appropriate institutional mechanisms are investigated so the government can reach a decision as to whether and how this activity should be transferred to the private sector.

The bill places this service within NASA by creating a unique organization[1] managed by a general manager and a deputy general manager appointed by the President, with the advice and consent of the Senate, and reporting to the NASA administrator[2]. The service would be responsible for all programs associated with Earth resources observation data[3]. It is probable, but not clear, that the Earth Data and Information Service (EDIS)

---

1 Section 7(a).

2 Section 6(b)(1)(2).

3 Section 3(7).

would be responsibile for the services currently provided by the EROS Data Center.

The unique characteristic of Senator Stevenson's bill is that the service would operate for a fixed term of up to seven years. Within 180 days of the end of that interim period the President shall make a recommendation to the Congress as to the appropriate organizational structure to carry on the functions of the service. Specifically enumerated within the bill are the options of a continuing as a federal agency, a government corporation or a private corporation[4].

The bill points out that Earth resources observation systems shall be regulated by the federal government[5], but does not specify the form of that regulation. Since the service would be an agency within NASA, the government would be undertaking this activity. The requirements of the Outer Space Treaty to "control and supervise" would thus be met. However, at the time the service was to be transferred to the private sector, one of the issues would be who would continue this responsibility. And, what are the appropriate mechanisms for that "control and supervision?"

The bill provides for intellectual property protection of the data wherein "it shall be unlawful for any person to reproduce for sale or distribution, or to sell or distribute, any data or basic information or product provided by the service"[6]. The bill specifically incorporates the fair use doctrine from the Copyright Act[7]. One of the considerations in the determination of what constitutes the fair use is the effect of that use on

---

4 Section 6(d).
5 Section 5(a)(4).
6 Section 10(a).
7 Section 10(b).

the potential market for and the value of the basic data information product[8]. It is interesting to note that the bill provides for civil penalties not to exceed $5,000 for each violation[9], but does not provide for injunctive relief.

Since this is an agency of the federal government there is no need to consider antitrust issues. However, at the time which the service should be transferred to the private sector this might become an issue.

The bill provides that there shall be charges, that is prices for the products, such that at the end of the interim period the income from those charges, combined with any other income that the service might obtain, will cover the costs of the service exclusive of the cost for research and development, and other types of research carried out by NASA[10]. To allow this recapture, the bill exempts the data from the Freedom Information Act, Title 5, U.S.C. Section 552.[11]

At such time as the organization is a viable entity, the President can transfer the functions of the service to some other organization. It is interesting to note that the President may transfer records, property, funds, personnel, etc.[12] The question that arises here is whether this is a direct transfer or whether there would be a recapture of the cost of operating the service up to the time of transfer. In other words, if a private corporation takes over the activities of this service, does it have to pay the federal government the fair market value for those properties which are transferred, including the intellectual property, the data?

---

[8] Section 10(b)(4).
[9] Section 10(c)(1).
[10] Section 9(a).
[11] Section 9(e).
[12] Section 12(a).

This bill makes a fundamental assumption that a market exists and that within government there are appropriate integrated institutional, managerial, financial, technical, marketing functions which would allow this service to make a profit[13]. It should be noted, however, that NASA specifically lacks this type of financial and marketing expertise.

S.875 (Schmitt)

The Earth Resources Information Corporation Act of 1979, S.875, 96th Cong., 1st Sess. (1979), as introduced by Senator Schmitt, would create a private corporation to establish and operate "as expeditiously as practicable a commercial Earth resources information service"[14]. This corporation would be formed by the President appointing incorporators, no later than two years after the enactment of the act, by and with the advice and consent of the Senate, who shall serve as an interim board of directors to file the articles of incorporation and arrange for the public offering of stock in the private corporation.

Once the corporation is officially chartered, it shall be managed by a board of directors, three of whom would be appointed by the President, with the advice and consent of the Senate, from persons among the Earth resources data user community. The Departments of Agriculture, Commerce, and Interior would each appoint one member to the board of directors. These departmental appointees would not be reviewed by the senate. One member shall be appointed by the National Association of State Governors, and ten members shall be elected from the stockholders[15]. The board of directors has the responsibility for setting up the administrative structure by appointing

---

[13] Section 6(a)(3)
[14] Section 102(a)
[15] Section 303(a)

officers[16] and all of the other activities associated with the formation of the corporation[17]. An interesting feature of Senator Schmitt's bill is that twenty percent of the shares of the corporation are restricted to government ownership[18] and foreign ownership is limited to less than twenty percent. No private holder may own more than ten percent of the shares of the corporation[19]. These provisions seem to evidence a desire to have the corporation have as broad an ownership base as possible.

The corporation would be responsible for all of the facets of obtaining Earth resources data, processing it, and marketing it to the various sectors[20]. This corporation is subject to regulation by the Federal Communications Commission (FCC)[21] and as such will have a rate making hearing characteristic of typical utilities[22]. That is, within the rate base there shall be allowed various kinds of debt and security instruments which will be allowed to earn the specified rate of return[23].

The duties of the corporation include:

1) "plan, initiate, construct, own, manage, and operate itself in conjunction with foreign governments or their designated entities a commercial Earth Resources Information service;
2) to take over the responsibility for all of the functions of the Earth Resources Observation System (EROS) Data Center
3) market earth resources raw and preprocessed data;
4) own and operate the Earth Resources satellites, aircraft and other appropriate data collection systems,
5) own and operate ground receiving stations; and
6) own and operate information distribution centers for the provisions of raw and preprocessed data.[24]

---

16 Section 303(a)
17 Section 305(d)
18 Section 304(b)(1)
19 Section 304(b)(2)
20 Section 305(a)
21 Section 102(d)
22 Section 201(c)(4)
23 Section 304(c)
24 Section 305(a)

The corporation is also mandated to market "value-added" Earth observation data through a subsidiary distribution corporation[25]. The security instruments marketed as part of the distribution corporation are eligible for inclusion in the rate base, but the voting stock of the parent corporation is not eligible for inclusion in the rate base[26].

Intellectual property protection is provided specificially within Section 402(b) wherein it states,

> "it shall be unlawful for any person, directly or indirectly, in any manner other than through the channels of data dissemination established by the Commission (FCC) and the corporation, to sell or disclose to any other person and Earth Resources information which is compiled by the corporation."

This statuary protection is not the same as that afforded by the Copyright Act. It should be noted that since this is a private corporation it is not subject to the Freedom of Information Act.

It is noted in the bill[27] that the corporation created by this Act will be consistent with Federal antitrust laws. The FCC has been mandated to at any time report to Congress its concerns with respect to any anticompetitive practices as they may apply to the Earth Resources Information Service along with a request for appropriate legislation.[28]

On its face the bill seems to assume that the requirement to "control and supervise" as encompassed in the Outer Space Treaty is sufficiently met by the structure of the board of directors who are largely appointed by the president and the various departments within the government.

---

25 Section 305(c)
26 Section 304(c)
27 Section 102(c)
28 Section 403(c)

The corporation is mandated to provide data and information at a "just and reasonable price" except where separate Earth resources information services are required to meet unique governmental needs[29]. Since this is a profit making corporation it would be expected that this just and reasonable price would allow for appropriate profits as a regulated industry.

Questions which arise with respect to this corporation focus on what types of antitrust concerns might be applicable. This bill does not create a monopoly in its own right. The corporation formed under this bill would undoubtedly have a monopoly for the term starting when it is created. This, however, is not a legal barrier to entry of other firms who wish to compete and provide other kinds of data. It is, in fact, a barrier to entry in that there will be an established organization who, based on the profits it makes from the initial activities, which might include Stereosat, would be able to exercise considerable influence over future activities.

Another question is whether or not this corporation would be considered to be a common carrier and subject to all of the appropriate FCC regulations.

Under the provisions of this bill there would be nondiscriminatory access to data[30] but statutory protection for its exclusivity[31]. The Act provides for up to $20 million in fiscal year 1981 to commence operation of the corporation[32].

H.R. 2337 (Fuqua)

The Space Industrialization Act of 1979, H.R. 2337, 96th Cong., 1st Sess. (1979), as introduced by Congressman Fuqua, would create a Space

---

29 Section 201(a)(7)
30 Section 102(c)
31 Section 402(b)
32 Section 404

Industrialization Corporation (SIC) to promote and assist in the development of new products, processes and industries in the space environment. The bill creates two operative elements. One is a corporation which begins as an agency of the U.S. government[33] for a term of 120 days[34] until such time as stock is sold and it becomes a publicly-owned corporation. The other is a federal government trust fund[35] of up to $50 million dollars per year for a maximum term of two years[36] to provide the initial capital for ventures undertaken by the corporation.

The corporation is managed by a board of directors[37], the chairman of which is appointed by the President with the advice and consent of the senate for a term of five years[38]. Three public sector representatives from within the executive branch of government are also appointed by the President. Eight private sector individuals are appointed by the President with the advice and consent of the senate, six from the industrial concerns with special expertise in industrial research and development, one from aerospace research and development, and one academic[39]. These people serve as long as the corporation is operating on the trust fund money. At such time as the trust fund is repaid, excluding certain overhead costs, the corporation would become entirely private[40], where upon the board of directors would be elected in the traditional stockholder fashion.

---

[33] Section 101(a)
[34] Section 101(b)
[35] Section 103(a)
[36] Section 103(b)
[37] Section 101(c)(1)
[38] Section 101(c)(1)(A)
[39] Section 101(c)(1)(C)
[40] Section 203(c)

It should be noted at the outset that this Space Industrial Corporation has a charter much broader than merely the acquisition of Earth resources information. The corporation functions based on proposals solicited[41] and unsolicited[42] wherein it provides funds to industrial ventures under a negotiated management plan to hopefully reduce entrepreneurial risk and create and support a profitable business enterprise.[43] The corporation would be repaid from profits if successful[44], and if the venture were unsuccessful, the private sector proposer would have to prepare documentation as to what went wrong[45]. The corporation is mandated to evaluate the proposal based upon the technical and economic viability. The criteria for making selections among the allocation of the resources of the trust fund are aimed at those which have high potential benefits as determined by the level of risk, the potential of recovery of capital and cost sharing[46].

Under the provisions of the bill the applicant has the rights to all intellectual properties until such time as the project is approved[47]. After that period, the negotiation for the long range management plan of this joint venture would include agreements with respect to patents, proprietary rights, and licensing in the use of products and information[48].

The applications, proposals, management plans, or financial or assistance agreements entered into by the corporation are exempt from the Freedom

---

[41] Section 102(b)(2)
[42] Section 102(b)(1)
[43] Section 102(a)
[44] Section 102(f)
[45] Section 102(g)
[46] Section 102(b)(2)(c)
[47] Section 102(i)
[48] Section 102(a)

Information Act, Title 5, U.S.C. Section 552[49]. However, if the corporation were to undertake Earth observation using Stereosat, there is no specific exemption of that data from the Freedom of Information Act.

There is no discussion of potential antitrust issues in this type of activity.

The "control and supervision" requirements are evidently met by the structure by the board of directors of the corporation, while it functions using the trust fund. At such time as the trust fund is repaid and the corporation becomes a private entity, there would be a question of continuing "control and supervision."

At the time the corporation becomes a private entity, there would be a question about continuing royalties and agreements.

Summary

These bills attempt to create an institutional structure under which Stereosat could be implemented. They also attempt to confront some of the issues which will constrain the structure created. It is not clear that any of these proposals can meet the goals and objectives of Stereosat. In particular, they do not enhance the flexibility of the private sector in responding to Stereosat. Also, it is difficult, given the lack of a consistent comparative methodology, to assess the benefits and detriments of each vis-a-vis the others. Therefore, in keeping with the "wait and see" recommendation discussed earlier, it may be appropriate for Congress to "go slow" in moving these bills towards passage and implementation. However, should Congress wish to move forward, the bills should be drafted to be responsive to the issues herein discussed.

---

[49] Section 102(1)

APPENDIX 3

STEREOSAT INSTITUTIONAL ASSESSMENT
SPACE LAW TREATIES

by

Martin Menter
Brig. General USAF (retired)
of Counsel
Haffer & Alterman
Washington, D. C. 20036

August 9, 1979

STEREOSAT INSTITUTIONAL ASSESSMENT SPACE LAW TREATIES

Situation

It is anticipated that Stereosat will provide third dimensional remote sensing earth imagery with a 15 meter instantaneous field of view (IFOV) resolution from a satellite in a sun synchronous 713-kilometer orbit. The Stereosat mission, in whole or part, may be undertaken by the government or by a joint private sector/government enterprise.

The present inquiry is addressed to the requirements in the 1967 Space Law Treaty[1] and applicable to the described, but as a nongovernmental, space activity.

Response

The Stereosat satellite orbit would clearly be in free outer space above the limits of subjacent states' sovereignty or jurisdiction[2]. If launched by the United States, its authorization and supervision over the activity is required. "Supervision" would be satisfied by issuance of regulations, by inspection, submission of required filings and reports and by investigation. It is the U.S. position that under the 1967 Treaty, there would be no limitation on the fineness of the image resolution unless imposed by the United States or subsequent international agreement.

The Space Law Treaties

The 1967 Space Law Treaty does envisage commercial activity in space. At

---

1 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. 18 UST 2410, TIAS 6347, 610 UNTS 205.

2 Ibid., Article II. Objects at an altitude permitting orbit of the earth are regarded as in outer space.

the time of its drafting, the Communications Satellite Corporation (COMSAT) was already organized and operating commercial communications satellites. It is Article VI of the Treaty that provides, "activities of non-governmental entities in outer space ... shall require authorization and continuing supervision by the State concerned." The Treaty's formulation was by the Legal Subcommittee of the United Nations' Committee on the Peaceful Use of Outer Space (COPUOS). The quoted wording here concerned was taken from a prior 1963 Resolution of the U.N. General Assembly[3] setting forth "legal principles" for the "guidance" of member states. In the Subcommittee's consideration of this principle, a predecessor recital presented by the Soviet Delegate stated: "All activities of any kind pertaining to the exploration and use of outer space shall be carried out solely and exclusively by States ..."[4]. Subsequently, in a discussion of private activity under "supervision" of a parent State, the Soviet delegate remarked:

> "The Soviet delegation considers it essential to point out that in this field it would be possible to consider the question of not excluding from the declaration possibility of activity in outer space by private companies, on the condition that such activity would be subject to the control of the appropriate State and the State would bear international responsibility for it"[5]

The final wording proposed, and accepted, was that proffered by the Soviet Union for Article VI previously recited herein, except for the

---

3 UN Resolution 1062 (XVIII), December 13, 1963.

4 UN Doc. A/AC.105/C.2/L/1., June 6, 1962, par. 7.

5 UN Doc. A/AC.105/PV.22, October 10, 1963, p. 23.

substitution on suggestion of the United States Delegate of the term "non-governmental entities" for "non-governmental bodies corporate".[6]

As to the U.S. obligation emanating from the "authorization and continuous supervision" requirement, the Senate Committee on Aeronautical and Space Sciences, in March 1967, was advised:

> " ... a nation which becomes a party to the treaty agrees to be responsible for space activities carried on by any ... non-governmental entity. For the United States, this means that the government would accept responsibility for the activities of ... the Communications Satellite Corporation (COMSAT), etc. Furthermore, the government would see that such activities conform to the Treaty's provisions, and also authorize and continuously supervise the space activities of non-governmental entities."[7]

With authorization and supervision, the nongovernmental entity may undertake in space any peaceful activity that its sponsor State could lawfully undertake. The four present space law treaties contain several provisions as to general and specific activities of States. Whether an activity may be for profit is a matter for domestic and not international determination. The problem, in any given case, is whether the activity is one the sponsor State may undertake under the Space Law treaties.

Pursuant to U.N. General Assembly resolutions, the Legal Subcommittee of COPUOS is giving priority and detailed consideration of the legal implications of remote sensing with the aim of formulating draft principles[8].

---

6 UN Doc. A/AC.105/PV.24 contains verbatim record of Legal Subcommittee meeting. Par. 5 of proposal becomes par. 5 of UN Res. 1962, see note 3, supra., and subsequently Art. VI of the Outer Space Treaty.

7 Senate Committee Print, 90th Congress, 1st Session, March 1967, of Staff Report for Committee on Aeronautical and Space Sciences, U.S. Senate, entitled "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies - Analysis and Background Data."

8 UNGA Res. 33/16, Nov. 17, 1978, par. 4(a).

The USSR and some other States propose inclusion of a principle that every State has the right to declare that certain types of primary data and analyzed information[9], obtained by remote sensing of its territory, may not be published or given to third States without its express consent. An example, frequently stated, is that such declaration of the sensed State may relate to primary remote-sensing data with a spatial photographic resolution limit of 50 meters and to analyzed remote sensing information obtained on the basis of such data. The reason generally recited for such limitation is that dissemination of data with a finer resolution might adversely affect the economic and/or defense interests of sensed States.[10,11,12]

It has been the consistent United States position that its Landsat program is pursuant to recitals of the 1967 Space Law Treaty, particularly that in Article I, viz: "Outer Space ... shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law ..."[13] It is also within the

---

9 For definition of terms, see UN Doc. A/AC.105/240, App. A, 10 Apr. 79.

10 The Scientific and Technical Subcommittee of COPUOS in its 1978 report noted "that according to experience gained so far in comparing the imaging capacity of photographic systems and scanner systems, the ratio between the photographic spatial resolution and the instantaneous field of view (IFOV) of a scanner as well as television resolution was approximately between two and three to one" (UN Doc. A/AC.105/216, March 6, 1978, p. 7, par. 25). Further study towards clearer understanding of various "resolutions" is under way. Certainly, there is more interest in spectral resolution than geometric resolution.

11 UN Doc. A/AC.105/240, Apr. 10, 1979 (Report of Legal Subcommittee, COPUOS, Annex I, App. B, p. 12; USSR Working Paper 1, Working Group III (1979), re Principle XVI of Remote Sensing Draft).

12 UN Doc. A/AC.105/28, February 26, 1979 (Report of the Scientific and Technical Subcommittee COPUOS), Annex I, p.3, par. 14.

13 Op.cit. note 1

recitals of Article I that States' space activities are to be for the benefit and interest of all countries and of Article VI that States conducting activities in outer space "inform the public and the international scientific community, to the greatest extent possible and practicable, of the nature, conduct, locations, and results of such activities ..." While the USSR and some other states contend that failure to obtain a sensed State's consent to dissemination of sensed data of such state is a violation of the sovereignty of such State under international law[14], Landsat imagery is being acquired and beneficially used by most countries. At the recent 1979 meeting of COPUOS (June 18-July 3), the U.S. Representative, Neil Hosenball (General Counsel, National Aeronautics and Space Administration), on June 20, 1979, stated:

> " ... the absence of any regime requiring the prior consent of sensed state before dissemination of data from such systems as Landsat or Seasat or information derived therefrom has been crucial to the success and wide acceptance the programs have experienced. We know of no adverse effects to any State resulting from the absence of a prior consent regime. We can foresee serious impediments and inequities arising if restrictive regimes are imposed which impede the flow of useful date on the natural resources of the earth and environment ..."[15]

Nevertheless, the lack of consensus within the Legal Subcommittee, COPUOS, on the issue of freedom of exploration of outer space versus national sovereignty over natural resources is the major reason for incompletion by the

---

14 See, Zhukov, G.P., Dr., "International Law Problems Related to the Exploration of Earth Resources from Outer Space", Proceedings of the Nineteenth Colloquium on the Law of Outer Space, Anaheim, California, October 12-15, 1976. Distributed by Fred B. Rothman & Co., Littleton, Colorado 80123.

15 Press Release, US Mission to the UN (USUN-61(79)), June 20, 1979.

Legal Subcommittee of its charge to complete its draft of principles on remote sensing of the earth.[16]

Other provisions of the 1967 Outer Space Treaty are apropos to consideration of "control and supervision." The recited requirement for the State's "authorization and continuing supervision" of a nongovernment entity in space is immediately preceded in Article VI by a sentence imposing

> "international responsibility for national activities in outer space ... whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty"[17]

Article VII of the Treaty imposes "international liability" upon the State party to the Treaty that launches or procures the launching of an object into outer space for damage to another State Party to the Treaty or to its nationals. The later 1972 "Liability Treaty"[18] imposes "absolute liability" upon a launching State "for damage caused by its space object on the surface of the earth or to aircraft to flight."[19] Liability for damage to another object in space would be based upon "fault". Thus, the U.S. would be liable

---

16 The COPUOS and its subcommittee arrive at its determination on the basis of "consensus", that is, there is no vote taken on issues. Where objections to proposals are made, discussion follows in an attempt to obviate the objection or to arrive at an acceptable compromise. A consensus is obtained when all persons raise no further objections. While a delegate may "abstain", it does not negate a consensus otherwise obtained. Hence, when a consensus is finally attained on a recommended draft agreement, UN concurrence, signature by States and ratification generally rather quickly follow.

17 Op. cit., note 1.

18 Convention on Liability for Damage Caused by Space Objects, March 29, 1972. 24 UST 2389, TIAS 7762, effective October 9, 1973.

19 Ibid., Art. II.

to foreign governments and its nationals for damages sustained by impacts of a privately owned Stereosat satellite from space.

Article VIII of the 1967 Space Law Treaty provides that the State on whose registry an object launched into outer space is carried "shall retain jurisdiction and control over such object, and any personnel thereof while in outer space." Further, that ownership of objects launched into outer space "is not affected by their presence in outer space ... or by their return to the Earth ...". Under the above, a nongovernment entity would retain legal title to all its equipment in outer space. In addition, the United States would be responsible to provide governing regulations for the security of privately owned objects or personnel in space, including imposition of penalties and constraints as may be found necessary to assure compliance with its regulations. A State permitting its nationals to engage in space activity retains its responsibility to assure that such activities are in compliance with the State's obligations under the Treaty, such as, ensuring that the activities will be conducted with due regard to the corresponding interest of other States and will avoid harmful contamination of space and any adverse changes in the environment of the Earth from introduction of extraterrestrial matter.[20]

The 1979 meeting of COPUOS reached a consensus on a draft "Agreement Governing the Activities of States on the Moon and on other Celestial Bodies." It is here interesting to note that Article XIV of the draft Agreement imposes similar "authorization and continuing supervision" language to that of Article VI of the 1967 Space Law Treaty relative to activities of

---

20 1967 Space Law Treary (Op. cit., note 1), Art. IX.

nongovernmental entities.[21] The U.S. Delegate to the meeting has orally advised the author that there was no explanatory paper to this wording of Article XIV, but that it was in fact patterned after Article VI of the 1967 Space Law Treaty.

Meaning of "Authorization and Continuous Supervision"

In the "Analysis of Treaty", the Senate Committee on Aeronautical and Space Sciences stated that under Article VI of the 1967 Space Law Treaty the government must "authorize and continuously supervise the space activities of non-governmental entities." It cites the then existing US/COMSAT relationship as such an example, viz: "The relationship between the U.S. Government and COMSAT is already defined in the U.S. Communication Satellite Act of 1962 concerning government supervision, including international aspects and the role of the Secretary of State."[22]

The most recent Black's Law Dictionary, defines "supervisor": "in a broad sense, one having authority over others, to superintend and direct." It

---

21 A/AC.105/L.113, July __, 1979 (no "date" yet available as report currently in printing). Article XIV provides:

"States Parties to this Agreement shall bear international responsibility for national activities on the moon whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Agreement. States Parties shall ensure that non-governmental entities under their jurisdiction shall engage in activities on the moon only under thee authority and continuing supervision of the appropriate State Party."

22 Op. cit., note 7. The Communications Satellite Act of 1962 (Pub. L. 87-624; 76 Stat. 419) directed the President to "provide for continuous review of all phases of the development and operation." The FCC and NASA were also given directed responsibilities (Section 201). COMSAT was made subject to the District of Columbia Business Act of 1934 as amended. By Ex Or 11191, January 4, 1965 (30 Fed. Reg. 29), President Johnson made specific delegations of his responsibilities under the Act.

then defines "superintend" as "to regulate with authority."[23] A vintage court decision construing the supervision responsibility of the Secretary of Interior relating to public land under Revised Statutes, Section 441, stated: "Webster says 'supervision' means to oversee for direction, to superintend, to inspect, as to supervise the press of correction." It was said by the Court to be "so used" in the statute "and hence the statute gives the Secretary, and under his direction, the Commissioner, of General Land Office, the power to review all the acts of the local officers, and to correct and direct a correction of any error".[24]

Certainly, each head of a government department or agency has supervision over the agency and the public programs it administers. Rules or regulations are published to govern particular programs. The Administrator of NASA in the performance of his functions, is given authority to promulgate rules and regulations to govern undertakings to carry out the purpose of the National Aeronautics and Space Act of 1958.[25] Compliance is generally assured by consultations, inspections and by investigations of reported discrepancies. There is nothing in the negotiated history of Article VI of the Space Law Treaty to warrant a construction that the words used were intended differently than their common accepted meaning. Under the 1967 Space Law Treaty, governments are recognized as authorized to undertake space activities either through its agencies or through nongovernmental entities for whose actions the government is responsible. The supervision required is to assure action

---

23 Black's Law Dictionary, 5th Ed. West Publishing Co., 1979.

24 Van Tongeren v. Heffernan, 38 N.W. 52, 56, 5 Dak. 180.

25 Sec. 203c(1). See also 18 USC 799 providing criminal penalties for violation of NASA Administrator's security regulations.

undertaken is in compliance with the government's obligations under the space treaty.[26] Unless the vesting of supervision is specifically limited, it would be a continuing responsibility. The Federal Communications Commission (FCC) has a continuing responsibility of assuring compliance with International Telecommunication Union (ITU) Radio Regulations, promulgated under the International Telecommunication Convention, 1973. Under the responsibility and authority given in the Communications Act of 1934[27], it implements the ITU regulations requiring various filings of FCC approval such as a request to construct a communication satellite and again later for its use and even its launching into space. Any satellite transmitting digital signals to earth, including stereosat, would be subject to FCC jurisdiction. It undertakes investigations upon its own motion, or upon complaint when a user appears not to be in compliance with regulations; for example, not operating within assigned frequencies. Today's businesses are subject to regulations set forth in many statutes and/or prescribed by many government corporations relating to their incorporation and operations, and requiring sundry filings. In a sense, the provisions here provide for further requirements for compliance.

---

26 The Administration will this September introduce a bill to revise the US Criminal Code. Included therein will be provisions applicable to space flight. This will be accomplished in part by defining the term aircraft as "any craft designed for navigation in air or in space." Thus many offenses in space would be embraced within the recitals pertaining to the "special aircraft jurisdiction" to be established by the bill. Further coverage would result from recitals in a section on "Extraterritorial Jurisdiction."

27 47 U.S.C. 152, 303.

An Operational Remote Sensing System

A White House press release of June 20, 1978[28], advised of the establishment by Presidential Directive of a National Security Council (NSC) Policy Review Committee (PRC), chaired by the Director of the Office of Science and Technology (OST), Dr. Frank Press, to provide a forum to review proposed space policy issues. Initially, the PRC was asked by the President to review the nation's civil space program. National policies were also established by the President's Directive. Space principles set forth therein included, among others, the development and operation on a global basis "of active and passive remote sensing operations" in support of national objectives, and:

> "the encouragement of domestic commercial exploitation of space capabilities and systems for economic benefit and to promote the technical position of the United States; however, all United States earth-oriented remote sensing satellites would require U.S. Government authorization and supervision or regulation."

Based on a four months interagency review following issuance of the White House June 20th Memorandum, the White House on October 11, 1978 announced a U.S. Civil Space Policy[29] which, among other recitals, would " ... provide for the private sector to take an increasing responsibility in remote sensing and other applications" and "confirm our support of the continual development of a legal regime for space that will assure its safe and peaceful use for the benefit of mankind."

---

28 Reprinted in Sen. Doc. 95th Cong., 2nd Sess. "Space Law - Selected Basic Documents" 2nd Edition (Committee print for Comm. on Commerce, Science and Transportation) Dec. 1978, p. 558.

29 Ibid., p. 561

The October 11th memorandum reflected the President's decision to continue to provide data from Landsat "for all class of users." Further, that operational uses of data from the experimental system will continue. Specific details of the Landsat system, including organizational factors, were to evolve over several years to include development of the potential to involve the private sector. A comprehensive plan including the private sector was to be explored for an integrated national remote sensing system.

A Policy Review Committee (Space) task force on "Private Sector Investment Study", under the co-chairmanship of Arnold Frutkin, NASA, and Wilbur Eskite, NOAA, has considered options for an operational remote sensing system from leaving it in government to turning the system over to commercial enterprise. This consideration included intermediate options of private sector investment and involvement. The task force report was submitted to the Council's Director on June 16th but has not yet been released.[30]

In the "Science and Technology Message of the President" transmitted to the Congress on March 27, 1979, the President stated that he was "committed to the continuity of remote sensing data over the coming decade ... "[31]

Dr. Press has testified that the Administration is committed to an operational remote sensing system. While NASA's Administrator Dr. Robert A. Frosch advised that the Administration believes that no legislation is desirable at this time, he has testified that " ... it is clear that our

---

30 Phone conversation, August 6, 1979, with Wilbur Eskite, Co-chairman of Task Force.

31 At p. 11, of printed message.

planned program comprises the essentials of progress toward an operational system of the sort ... S.663, contemplates."[32]

The reference above to S.663, of course, is to Senator Stevenson's proposal introduced on March 14, 1979 and cited as the "Earth Data and Information Service Act of 1979". It seeks to establish in NASA an Earth Data and Information Service to provide earth resources data. It is a government agency and all its earth-oriented remote sensing satellites are to be regulated by the Federal Government. The Service will exist for an interim period not to exceed seven years. Within this period, but not later than six months before the end thereof, the President is to report to Congress on the appropriate organizational arrangement best designed to continue the functions of the Service as a Federal Agency, or a government corporation or as a private corporation.

It here suffices to say that as S.663 provides for a Government agency, the provisions of the 1967 Space Law Treaty as to "authorization and continuing supervision" would not be applicable. It would, of course, apply after the interim period if the Congress vested the operational remote sensing responsibilities in a private corporation.

S.875, 96th Congress, introduced by Senator Schmitt, provides for an operational earth resources system in the form of a private corporation, the Earth Resources Information Corporation, to be established by the Act. The FCC is to have regulatory responsibility over the Earth resources information services.[33] Recitals apparently patterned after the communication Satellite

---

32 Statement before Subcommittee on Science, Technology and Space, Senate Committee on Commerce, Science, and Transportation, April 9, 1979.

33 Sec. 102(d), S. 875, 96th Congress.

Act of 1962, direct the President to "provide for continuous review of the development and operation of an Earth resources corporation authorized under ... the Act."[34] Further supervision is directed relative to international relationships and utilization of advances in Earth imaging under controls, as appropriate. The remainder of the measure, in vesting responsibilities in NASA and the FCC, is also patterned after the COMSAT Act. The government authorization and continuous supervision requirements of the 1967 Space Law Treaty would be satisfied under this measure, although it appears that attempting to expand under Section 102(d) the FCC's normal regulatory responsibility to general responsibility for the system of [illegible] resources information services envisaged by the Act will meet serious opposition.[35]

Both Senator Stevenson and Senator Schmitt have stated that a single revised compromise bill will be substituted for S.663 and S.875 in the new session of Congress. Introduction of the substitute proposed is expected in September.[36]

---

34 Sec. 201(a), S. 875, 96th Congress:
"Earth resources information services," as defined in Sec. 103 of the proposal, "refers to a system of satellites and other appropriate data collecting systems capable of monitoring Earth and near-earth resources, transmitting this raw data to Earth receiving stations, the processing of this data for use by the user organizations and the distribution of the processed data to those requesting it." This also to include certain associated equipment and facilities for tracking, guidance, control and command functions.

35 Lukasic, Stephen J., Chief Scientist, FCC, on July 31, 1979, testified that "such regulatory oversight ... be sought elsewhere within the Federal establishment." Of course, he was not referring to normal FCC responsibilities under ITU Radio Regulations or under the Communications Act of 1934, as amended. Similar recommendation of not assigning general regulatory responsibility was given by Mr. Daniel J. Fink, V.P., General Electric Co., on April 11, 1979.

36 Stated by Sen. Schmitt in conversation with writer, following Hearing.

H.R. 2337, introduced by Mr. Fuqua on February 22, 1979, seeks to establish a Space Industrial Corporation, to promote, encourage, and assist in the development of new products, processes, and industries, using the properties of the space environment. The measure basically sets up a corporation to provide funds to industry for space industrialization projects, conceivably including remote sensing. Initially, the Corporation to be established would be a Government corporation, but when the Corporate Board, with the approval of the President, determines that public ownership can realistically be secured, it undertakes prescribed action to effect such. When so effected the corporation will be a private corporation. It is not unequivocal that sufficient supervision to satisfy the 1967 Space Law Treaty requirements would exist over private enterprises in space that secured fund support from the Corporation, notwithstanding their agreement to comply "with all provisions of this Act and all rules and regulations promulgated thereunder", and particularly after indebtedness to the corporation has been discharged. The satisfaction of the treaty obligations for continuous supervision would appear at least equally tenuous when the Corporation becomes a private public-owned entity.

Whether a private corporation created by statute and vested with monopoly over a given space subject, or whether through a Request for Proposal (RFP), a private corporation is awarded monopoly responsibility over the subject, the 1967 Space Law Treaty requirement for supervision by the government must be satisfied. As the government is financially responsible for damages to another State or its inhabitants, it should assure, insofar as feasible, safe operation of its nationals' space activity, including compliance with the State's treaty obligations. These include, among others, promoting international cooperation and understanding, with due regard to corresponding

interest of other states and to avoid harmful interference with activities of other States. Consistent therewith, it would be appropriate as conditions for grant of authorization, to assure nondiscrimination in access to information obtained, establishment of just and reasonable prices (perhaps supervision of accounting and ratemaking procedures), and prescribing standards of quality of product and service rendered. While some of the foregoing may be subject to discussion, the sponsoring State to comply with the supervision requirement must issue regulations to govern activities in space and assure compliance with the State's treaty obligations. Regulations could be set forth in the congressional enactment(s) as well as by government agencies vested with the required regulatory authority. Compliance may be determined, among other means, by inspections, filings, reports and investigations.

Congress has broad discretion as to the type of corporation it creates by statute and to the limitations or freedom it provides the corporation. One further type that could be tailored, if desired, is a mixed ownership corporation in which both the government and the private participants own stock in the corporation, as AMTRAK. This may be a half-way approach for the start of the desired enterprise with authority provided in the statute for the corporation to redeem government-owned shares as its profits permit.

The 1978 COPUOS report reflects its view that progress to date suggests

> " ... that remote sensing systems would one day, like weather and communications systems, become operational, and when that occurred, the use of satellite data could be expected to become an integral part of national economics and their planning activities."37

---

37 UN Doc. General Assembly Official Records: Thirty-third Session, Supplement No. 20 (A/33/20).

Problems and/or Activities for Future Consideration

A number of issues remain to be examined:

1) probable claims of developing States, and perhaps others, to share in profits of a private corporation engaged in acquisition of Stereosat imagery, even where the private company is concerned only with enhancing the data. (Compare, for example, the claim of equatorial states to segments of the geostationary orbit);

2) need to protect against unauthorized reproduction and sale of Stereosat imagery;

3) protection of proprietary interest - patents;

4) indemnification insurance arrangements;[38]

5) survey of government agencies' regulatory authorization and procedures to assure compliance;

6) whether to recommend the agency or agencies to have responsibility for authorizing and supervising an operational, not a research and development, earth remote sensing system (including Stereosat criteria to be considered);

7) whether to draft or support other drafted legislative proposals, in whole or in part.

---

38 See Section 308 ("Insurance and Indemnification") of the National Aeronautics and Space Administration Act, F.Y. 1980; Pub. Law 96-___ (H.R. 1786 now awaiting President's signature).